GE Energy

D400 Substation Gateway

Hardware User's Manual

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General

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D400 Substation Gateway

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D400 Substation Gateway

About this Document

Purpose

This manual provides information about installing, setting up, using and maintaining your D400™ Substation Gateway. This manual does not provide any procedures for configuring the software of the D400.

Intended audience

This manual is intended for use by field technicians and maintenance personnel who are responsible for the installation, wiring and maintenance of SCADA equipment. This guide assumes that the user is experienced in:

- Electrical utility applications
- Electrical wiring and safety procedures
- Related other manufacturers' products, such as protective relays and communications equipment

Additional documentation

For further information about the D400, refer to the following documents.

- *D400 Substation Gateway Software Configuration Guide* (SWM0066)
- *D400 online Help*
- Module layouts, as available

How to use this guide

This guide describes how to install the D400 and get it up and running for the first time.

Procedures are provided for all component options available for the D400. The components included in your D400 depend on what was ordered for your substation application. Follow only the procedures that apply to your D400 model. To check what options are included in your D400, see See “Ordering guide” on page 18..

The software-related procedures in this guide are based on using a computer running Windows® XP. Some steps and dialog boxes may vary slightly if you are using another version of Windows.

Document conventions

The following typographic conventions are used throughout this manual:

Bold face is used for:

- Names of software program menus, editors, and dialog boxes; also for the names of menu commands, keyboard keys, icons and desktop shortcuts, and buttons and fields in editors and dialog boxes
- Names of hardware components
- User input that must be typed exactly

Italic face is used for:

- Emphasis
- Cross-references to sections, figures and tables within this manual and for titles of other documents
- File and directory names; examples of directory paths are generally given in the Windows format
- Placeholders for user input that is specific to the user. May also include angle brackets around the placeholder if the placeholder is already in italic text. For example, c:\<*product*>\product.def
- References to a parameter or field value shown

Safety words and definitions

Before attempting to install or use the device, review all safety indicators in this document to help prevent injury, equipment damage or downtime.

The following safety and equipment symbols are used in this document:

Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

Indicates practices that are not related to personal injury.

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Product Support

If you need help with any aspect of your GE Digital Energy product, you have a few options.

Search technical support

The GE Digital Energy Web site provides fast access to technical information, such as manuals, release notes and knowledge base topics at:

http://www.gedigitalenergy.com

Contact customer support

The GE Digital Energy Customer Service Center is open 24 hours a day, seven days a week for you to talk directly to a GE representative.

In the U.S. and Canada, call toll-free: **1.800.547.8629**

International customers, please call: **+ 1 905.294.6222**

Or e-mail to ge4service@ge.com

Have the following information ready to give to Customer Service:

- Ship to address (the address that the product is to be returned to)
- Bill to address (the address that the invoice is to be sent to)
- Contact name
- Contact phone number
- Contact fax number
- Contact e-mail address
- Product number / serial number
- Description of problem

The Customer Service centre will provide you with a case number for your reference.

Product returns

A Return Merchandise Authorization (RMA) number must accompany all equipment being returned for repair, servicing, or for any other reason. Before you return a product, please contact GE Digital Energy to obtain an RMA number and instructions for return shipments.

You will be sent the RMA number and RMA documents via fax or e-mail. Once you receive the RMA documents, attach them to the outside of the shipping package and ship to GE.

Product returns will not be accepted unless accompanied by the Return Merchandise Authorization number.

Upgrade your D400 Substation Gateway firmware

The firmware of your D400 Substation Gateway can be upgraded to provide the latest functionality and improvements. Visit the customer support web site at http://www.gedigitalenergy.com to download the upgrade software and instruction guide.

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D400 Substation Gateway

Chapter 1: Before You Start

Before you begin installing and using the D400, review the information in this chapter, including the following topics:

- Safety precautions
- Regulatory compliance information
- Product overview
- Product specifications
- Storage recommendations

Read and thoroughly understand this guide before installing and operating the unit. Save these instructions for later use and reference.

⚠WARNING **Failure to observe the instructions in this manual may result in serious injury or death.**

Safety precautions

Follow all safety precautions and instructions in this manual.

Only qualified personnel should work on the D400. Maintenance personnel should be familiar with the technology and the hazards associated with electrical equipment.

- *Never* work alone.
- Before performing visual inspections, tests, or maintenance on this equipment, isolate or disconnect all hazardous live circuits and sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of back feed.
- Turn off all power supplying the equipment in which the D400 is to be installed before installing and wiring the D400.
- Operate only from the power source specified on the installed power supply module.
- Beware of potential hazards and wear personal protective equipment.
- The successful operation of this equipment depends upon proper handling, installation, and operation. Neglecting fundamental installation requirements may lead to personal injury as well as damage to electrical equipment or other property.

- All AC voltage terminals are protected from accidental contact by a mechanical safety shield.
- All electronic components within the D400 are susceptible to damage from electrostatic discharge. To prevent damage when handling this product use approved static control procedures.
- Hazardous voltages can cause shock, burns or death. To prevent exposure to hazardous voltages, disconnect and lock out all power sources before servicing and removing components.
- If the D400 is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.
- Changes or modifications made to the unit not authorized by GE Digital Energy could void the warranty.

Warning symbols

The following table explains the meaning of warning symbols that may appear on the D400 or in this manual.

Table 1: Warning symbols that appear on the D400 and in this manual

	The relevant circuit is direct current.
	The relevant circuit is alternating current.
	Caution: Refer to the documentation for important operation and maintenance instructions. Failure to take or avoid specified actions could result in loss of data or physical damage.
	Warning: Dangerous voltage constituting risk of electric shock is present within the unit. Failure to take or avoid specified actions could result in physical harm to the user.
	Earth/Ground Terminal
	Protective Ground Terminal
	Caution: Hot Surface

Regulatory compliance information

CE Mark compliance

The D400 is rated as CISPR 11 Group 1 Class "A" equipment.

NOTE

To provide higher EMC immunity and maintain CE Mark compliance, the serial cables used for permanent RS-232 and RS-485 connections must comply with the following requirements:

- Cables must be shielded
- D type connector covers must provide EMC shielding (e.g. metallized plastic or die cast metal covers) for permanently connected RS-232 cables

NOTICE

Class "A" equipment is intended for use in an industrial environment. The equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause interference to other devices in the vicinity. If this equipment does cause interference with other devices, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving device
- Increase the separation between the equipment
- Connect the equipment into an outlet on a circuit different from that to which the other device(s) is connected
- Consult the manufacturer or field service technician for help

Restriction of Hazardous Substances (RoHS)

The environmental protection use period (EPUP), as defined in PRC SJ/T11363-2006, for the D400 hardware assemblies listed in the table below is in excess of 20 years.

Table 2: RoHS Material Declaration Data Content by Assembly

GE Item #	Description	Lead (Pb)	Mercury (Hg)	Cadmium (Cd)	Hexavalent Chromium (Cr6)	Polybrominated biphenyls (PBB)	Polybrominated diphenyl ethers (PBDE)
500-0340	Chassis Assy	X	0	0	0	0	0
520-0190	Power Supply Blank Assembly	0	0	0	0	0	0
520-0191	Adapter Blank Assembly	0	0	0	0	0	0
520-0204	650 MHz Celeron w Single Ethernet	X	0	0	0	0	0
520-0205	1.0 GHz Celeron w Single Ethernet	X	0	0	0	0	0
520-0206	USB KVM Assy	X	0	0	0	0	0
520-0207	RS-232 IO Assy	X	0	0	0	0	0
520-0208	RS-485 IO Assy	X	0	0	0	0	0
520-0209	Glass Fiber Optic IO Assy	X	0	0	0	0	0
520-0210	Plastic Fiber Optic IO Assy	X	0	0	0	0	0
520-0211	IRIG-B Input Assy	X	0	0	0	0	0
520-0212	IRIG-B Distribution Assy	X	0	0	0	0	0
520-0213	Ethernet 4 Port Switch Assy	X	0	0	0	0	0
520-0214	Hot Standby Ethernet Glass Fiber Optic Assy	X	0	0	0	0	0
520-0215	100Base-FX Hot Stdby. Fiber Optic Eth. Adap.	0	0	0	0	0	0
520-0216	DC-DC Supply 5V 12A Assy	X	0	0	0	0	0
520-0217	AC-DC Supply 5V 12A Assy	X	0	0	0	0	0
520-0218	Redundant TP Ethernet + COM2 Port Assy	X	0	0	0	0	0
520-0219	COM2 Port Assy	X	0	0	0	0	0
580-3410	PC/104-Plus 10/100 Base-TX Ethernet RTL8110SC	0	0	0	0	0	0
977-0544	Cable Assy, C-GRID, 12SKT-10SKT+4SKT	0	0	0	0	0	0
977-0209	Cable, UTP Patch Cord Stranded, 60 Inch	0	0	0	0	0	0
977-0529	Cable, Null Modem DB9F-DB9F, 80°C, 150V, 72 Inch	0	0	0	0	0	0

O Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this item is below the limit required in PRC SJ/T11363-2006 and EU Directive 2002/95/EC (RoHS)

X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this item is above the limit requirement in PRC SJ/T11363-2006 and EU Directive 2002/95/EC (RoHS)

The maximum concentration limits (MCV's) apply.

Lead (Pb)	0.1% by weight	=	1000 mg/kg	=	1000 ppm
Mercury (Hg)	0.1% by weight	=	1000 mg/kg	=	1000 ppm
Cadmium (Cd)	0.01% by weight	=	100 mg/kg	=	100 ppm
Chromium VI (Cr6)	0.1% by weight	=	1000 mg/kg	=	1000 ppm
PBB, PBDE	0.1% by weight	=	1000 mg/kg	=	1000 ppm

Product overview

The D400 Substation Gateway is a secure, substation hardened and CE Marked communications gateway that collects metering, status, event and fault report data from intelligent electronic devices (IEDs). It summarizes the data from devices and makes it available to a master station or host computer over standard SCADA protocols. TCP/IP network connections are supported over the built-in 10/100 MB Ethernet interface and dial-up (external modem required).

The D400 comes with a built-in human machine interface (HMI)/annunciator as part of the base software. A Local HMI can be accessed through the Keyboard, Video, Mouse interface. A full featured substation HMI is accessed using a standard Web browser (HTTP/HTTPS) network connection. The D400 is configured "online" through a standard Web browser.

Hardware overview

The D400 is built on a flexible, high-performance, expandable platform powered by a 650 MHz or 1.0 GHz processor. It is distinguished by the noticeable lack of a hard drive and fan, employing instead the rugged and reliable CompactFlash mass storage and engineered heat sink and ventilation.

The D400 supports various communication media types through a choice of input/output (I/0) adapter cards:

- Serial (up to 8 configurable 2-port adapter cards): RS-232, RS-485, Fiber Optic (Glass or Plastic)
- Ethernet: 10/100BaseT, 100BaseFX, or 10BaseFL/100BaseSX

Figure 1: D400 - front view

Features

- Secure Web server (128-bit encryption)
- Secure SCADA communications through Secure Sockets Layer or Transport Layer Security (SSL/TLS)
- Secure access using SSH (Secure Shell)/SCP (Secure Copy)/HTTPS
- Secure terminal server, gateway, and/or data concentrator using SSL
- User configurable access level
- Support for remote user authentication
- Built-in alarm annunciator
- Support for time synchronization signals, including Network Time Protocol (NTP) and IRIG-B
- Support for DNP protocol for communications to multiple masters
- High-performance real-time database engine
- Internal Mini SQL™ database for archival of SOE and alarm records
- Built-in basic math/logic functions
- Event notification (e-mail)
- Portable memory device plug-in
- Dual CompactFlash cards for main and user storage
- Dual hot swappable power supply units
- Hot swappable communication adapter cards

Ordering guide

The latest D400 Substation Gateway ordering guide, which includes accessories, is available on the GE Digital Energy website:
http://www.gedigitalenergy.com/multilin/catalog/Gateways_RTU.htm

You can select the required options from the available Product Option items. The Order Code automatically updates as each option is selected.

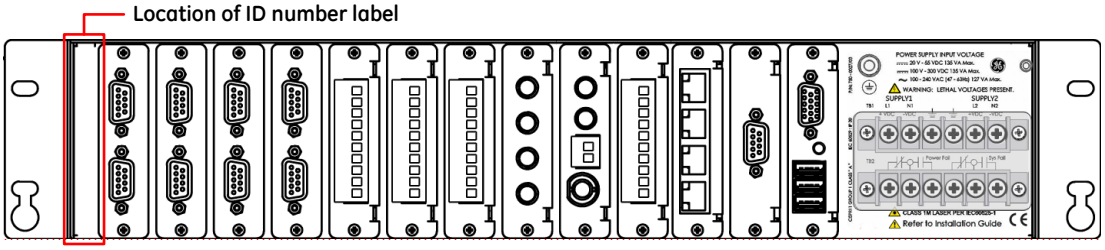
The Product Options are:

- D400 CPU Options
- Power Supply Options - Slot 1
- Power Supply Option - Redundant
- Serial Communication Slot 1 8
- Irig-B Input Card Option (Slot 9)
- Irig-B Distribution Card Options (Slot 10)".
- First Network Slot Option
- Second Network Slot Option
- USB KVM, Audio
- D400 Local HMI (One Line Viewer)
- D400 IEC61850
- D400 Logiclinx Executor License
- D400 Utilities
- D400 Image Firmware
- D400 FDIR Options

Product identification number

The D400 comes with an ID number that identifies the supplied options and hardware configuration of the unit. This ID number is composed of * followed by 6 alphanumeric characters. The ID number is listed on a label located next to Slot 1 on the rear panel of the D400.

Figure 2: D400 identification number



Product specifications

The D400 adheres to the following system, communications, electrical, physical and environmental specifications. Additional Standards and Protection are listed in *Appendix A, Standards & Protection.*

System

Processor	650 MHz or 1.0 GHz Embedded CPU
Memory	512 MB of PC133 SDR RAM or 1 GB of PC133 DDR RAM 16 MB NVRAM standard for persistent event storage

Storage	No hard drive 512 MB Main Silicon Systems® CompactFlash card 256 MB User Silicon Systems CompactFlash card Both expandable to 2 TB, depending on available capacity of industrial CompactFlash cards
Operating system	Linux
Embedded Mini SQL database	Archive of SOE reports, alarm records, operator notes, HMI quality changes, PRFs, and point tags
LED indicators	**Main module** System status: Power, Ready, IRIG-B and Network port status Serial port status: Transmit and Receive status per port **Power Supplies** Power on (Green)

Communications

Network connections	Single or optional dual redundant Ethernet interface Single Ethernet interface Fiber Optic and/or Twisted Pair 10/100BaseT (Isolated RJ-45 connector) 100BaseFX (Fiber Optic: 1300 nm, 50/125 µm, 62.5/125 µm multi-mode duplex fiber cable-ST connectors) 10BaseFL and 100BaseSX (Fiber Optic: 820 to 850 nm, 50/125 µm, 62.5/125 µm, 100/140 µm, and 200 µm HCS (hard clad silica) multimode duplex fiber cable-ST connectors) Data rate: 10 MBps and 100 Mbps
Serial communications	16 channels: RS-232/RS-485/Fiber optic Data rate: 300 to 115.2 Kbps **RS-232** Configurable for DCE/DTE operation Galvanic isolation Can drive IRIG-B signal to RS-232 ports (with optional IRIG-B Input card) **RS-485** 2-Wire/4-Wire support Galvanic isolation **Fiber Optic** Glass Optical Fiber serial port: (820 to 850 nm) 50/125 µm, 62.5/125 µm, 100/140 µm and 200 µm HCS multi-mode fiber with ST connectors Plastic Optical Fiber (POF) serial port: (660 nm), 1 mm core with Agilent Versatile Link Simplex connectors. POF is limited to a maximum of 38.4 kbps. Configurable ambient state (ON/OFF)
Time synchronization	**IRIG-B Input Module** IRIG-B format pulse width coded (PWC) signal, HCMOS or TTL levels on terminal block, IRIG-B format 1kHz AM modulated signal on BNC connector, and IRIG-B PWC signal on Fiber Optic (820 to 850 nm) ST connector. CPU time sync for internal database time stamping **Distribution Module** Can drive IRIG-B TTL signal from the input module for 16 IEDs **Signal Propagation** Propagated to all 16 RS-232 ports for devices Propagated to the distribution module
USB KVM & Audio	Three USB v1.1 compliant Type A ports for connecting keyboard, mouse, or touchscreen HD D-Sub 15 socket for connecting an industrial SVGA display (in accordance with VESA® Plug & Display Standard)3.5 mm stereo audio jack for audible alarms
User connections	Front Ethernet port for local connection to HMI Two USB v1.1 compliant Type A ports for USB device plug-in, such as keyboard, mouse, or touchscreen Front serial communication port (RS-232) for local maintenance
Network connections	Single or optional dual redundant Ethernet interface Single Ethernet interface Fiber Optic and/or Twisted Pair 10/100BaseT (Isolated RJ-45 connector) 100BaseFX (Fiber Optic: 1300 nm, 50/125 µm, 62.5/125 µm multi-mode duplex fiber cable-ST connectors) 10BaseFL and 100BaseSX (Fiber Optic: 820-850 nm, 50/125 µm, 62.5/125 µm, 100/140 µm, and 200 µm HCS (hard clad silica) multimode duplex fiber cable-ST connectors) Data rate: 10 MBps and 100 Mbps

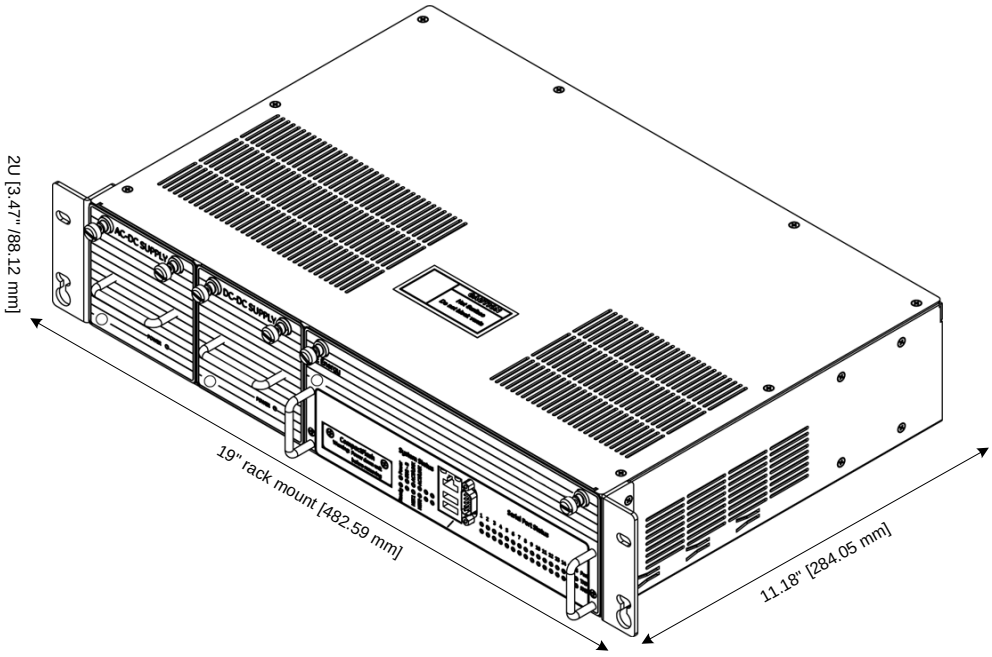
Electrical

Rated power supplies	**AC-DC**	100 to 240 VAC (±10 %) 127 VA maximum Minimum/Maximum AC voltage: 90 VAC / 265 VAC 100 to 300 VDC (±10 %) 135 W maximum Minimum/Maximum DC voltage: 88 VDC / 330 VDC
	DC-DC	20 to 55 VDC (±10 %) 135 W maximum Minimum/Maximum DC voltage: 18 VDC / 60 VDC
Peak inrush current at 25 °C on cold start	**AC-DC**	26.5 A_{peak} (< 145 VAC or 205 VDC) 40 A_{peak} (< 264 VAC or 370 VDC)
	DC-DC	35 A_{peak} (< 60 VDC)
Rated frequency (AC-DC)	47 to 63 Hz (50/60 Hz)	
Contact closures	Solid-state photo-MOS device Output ratings at maximum ambient temperature: – Continuous current: 0.1 A continuous at 300 VAC or 300 VDC – Peak current: 0.28 A peak for 10 ms – Maximum on resistance: 35 ohm – Dielectric isolation: 2 kV_{RMS}	

Physical

Overall height	2U (3.47") [88.12 mm]
Width	19" rack mount [482.59 mm]
Depth	12.24" [310.95 mm] for chassis and rear connectors 13.04" [331.34 mm] with front clearance for protruding parts
Recommended cable clearance	3.75" [95.25 mm] for units with fiber optic connections 2.0" [50.8 mm] for units without fiber optic connections
Recommended work area clearance	36" [0.91 m] depth by 30" [0.76 m] width on front and back of device.
Unit gross weight	15.4 lb [7.0 kg]
Packing carton	Size: 23.6" x 16.1" x 14.6" [600 mm x 410 mm x 372 mm] Gross Weight: 20.0 lb [9.1 kg]
Material/Finish	Galvannealed steel with black power coat

Figure 3: D400 dimensions



Environmental

Operating temperature	–20 °C to +65 °C Maximum ambient temperature is +50 °C for unit to fully comply with *IEC 61010-1 Section 10.1* regarding surface temperature limits for protection against burns. Plastic optical fiber lower limit is 0 °C

The top cover of the D400 can get hot during peak operation. Ensure that there is at least 1U (1.75 inch [44.45 mm]) of free space above the D400 unit for proper ventilation.

When the unit is operating above 50 °C ambient temperature, safe handling precautions are recommended to prevent burns.

Humidity rating	5 % to 95 % relative humidity, non-condensing
Environmental rating	Ingress protection: IP30 (IEC 60529)
Installation / overvoltage category	CAT II (2)
Pollution degree	2
Use	Indoor use only
Altitude	Maximum altitude 6,560 ft [2000 m]
MTBF (MIL-217F)	39,400 hours at 40 °C in a fully loaded single Ethernet configuration

Software

Firmware	Supports various IED and host protocols as well as web-based user interface and secure access
Human machine interface	Built-in graphical user interface (Web browser-based)
Configuration	Built-in graphical user interface (Web browser-based)

Storage recommendations

Storage conditions

Always store the D400 in an environment compatible with operating conditions. Recommended environmental conditions for storage are:

- Temperature: –40 °C to +90 °C
- Relative humidity: 5% to 95%, non-condensing

Exposure to excessive temperature or other extreme environmental conditions might cause damage and/or unreliable operation.

Battery life

To maintain the life of the battery, the battery should be removed if the D400 will be powered down or stored for more than two weeks.

See “Replacing the battery” on page 98.

The battery sustains the NVRAM. If the battery is removed, the NVRAM storage will be lost.

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Chapter 2: Installing the D400

This chapter covers the following topics:

- Overview of the steps and tools required to install the D400
- Tour of the product features
- Physical installation the D400 in a rack or substation panel

⚠CAUTION

Before you install and operate the D400, read and follow the safety guidelines and instructions in "Safety precautions" on page 13.

Installation steps

The installation procedure will vary depending on the components ordered and shipped with your D400. Follow the procedures in this manual that apply to the specific hardware configuration of your D400.

Follow these main steps to install and set up the D400

1. Mount the D400 in the rack or panel. See "Physical installation" on page 26.
2. Install the supplied battery on the D400 main board. See "Replacing the battery" on page 98.
3. Set up the communication cards. See Chapter 3, *Setting Up Communication Cards*.
4. Make device and network connections. See *Chapter 4, Connecting to Devices and Networks*.
5. Make power connections and verify operation. See Chapter 5, *Powering Up the D400*.
6. Set up the D400's network interface. See Chapter 6, *Setting Up the D400*.
7. Start using the D400's tools and utilities to configure and monitor the operation of the D400. See Chapter 7, *Using the D400*.

Required tools

Before beginning the installation procedures, have the following tools and equipment available:

- Appropriate device cables for serial connections
- CAT5 network cables for RJ-45 Ethernet connections
- Flathead screwdriver with 0.6 mm by 3.5 mm blade (for terminal block wiring)
- Flathead screwdriver with 0.3 mm by 2.5 mm blade (for removing and installing the adapter cards and changing switch positions)
- #1 Phillips screwdriver (for power terminal block wiring and adapter card removal)
- #2 Phillips screwdriver (for rack mounting the unit)
- Needle-nose pliers
- Wire cutters
- Wire strippers
- Wire-crimping tool (Panduit® CT-1525 or equivalent)
- 6 fork connectors, Panduit part number PV14-6F for 16-14 AWG [1.3-2.1 mm^2] wire or PV18-6F for 22-18 AWG [0.3-0.8 mm^2] wire (or equivalent) for terminal block connections
- 1 ring connector, Panduit part number PV10-14R for 12 AWG [3.3 mm^2] wire for protective earth terminal
- Approved network settings for the device
- Windows-based PC with HyperTerminal® (or any Windows-based terminal emulation software) and Web browser software installed

Unpacking the D400

Carefully remove the D400 from its packaging. Visually inspect the unit to ensure it has not sustained any visible damage during transit. If there are visible signs of damage, *report it immediately to the carrier.*

Package contents

The following items are provided as part of your D400 shipment:

- D400 unit (Product ID D400*XXXXXX)
- Ethernet cable, 60 inch [1.5 m], (GE Item No. 977-0209/60) for local network connection
- Serial null modem cable, 72 inch [1.8 m], (GE Item No. 977-0529/72) for local maintenance connection
- ½ AA 3.6 V Lithium Battery (GE Item No. 980-0038)
- Substation Automation products - Documentation CD (GE Item No. 588-0056)
- Mini SQL Proof of License (GE Item No. 580-1703)

Verify that you have received all items. GE parts include a unique GE item number, typically in the format XXX-XXXX, that can be used as a reference.

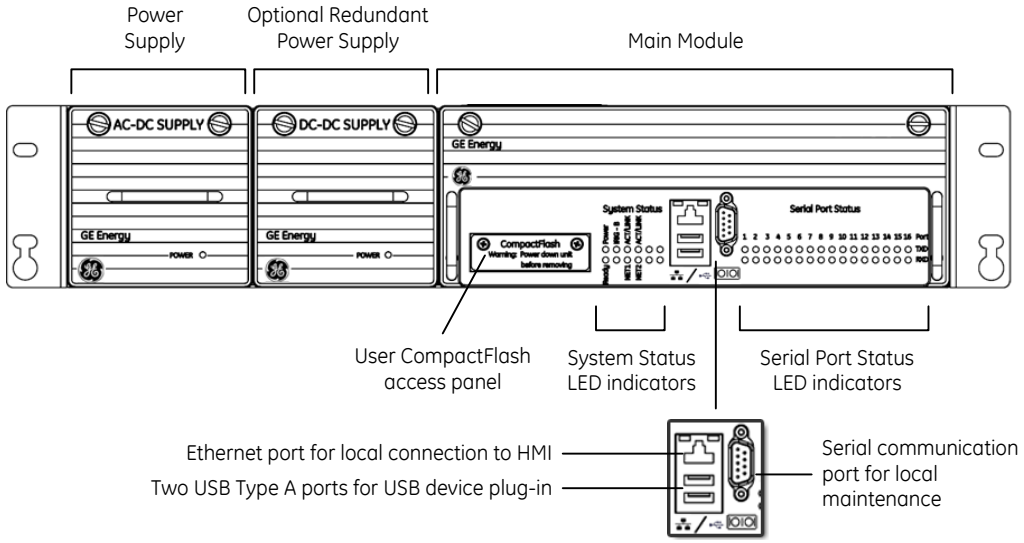
Verify the hardware configuration of the D400 using the Product ID number. For an explanation of the Product ID. *See "Ordering guide" on page 17*..

First look at the D400

Front Panel

The front panel of the D400 provides easy access to the status indicators, user connections and power supply units.

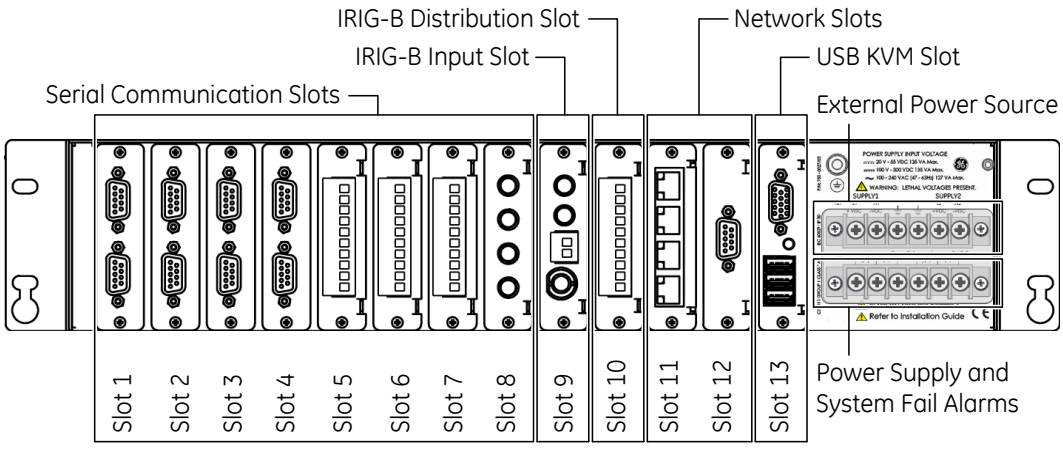
Figure 4: D400 front panel



Rear panel

The rear panel provides access to the communication ports, field wiring connections and power connections.

Figure 5: D400 rear panel



The D400 contains 13 I/O adapter card slots for the communication cards. The communication cards are powered from the backplane of the D400. The types of communication cards included in your D400 depend on what was ordered for your substation application.

Physical installation

The D400 can be installed in a standard 19-inch rack or substation panel. The D400 is supplied with a ½ AA 3.6 V 0.9 Ah Lithium battery that you must insert on the D400 main board when the D400 is installed.

The top cover of the D400 can get hot during peak operation. Ensure that there is at least 1U (1.75 inch [44.45 mm]) of free space above the D400 unit for proper ventilation.

When the unit is operating above 50 °C ambient temperature, safe handling precautions are recommended to prevent burns.

Rack mounting

The D400 mounts directly into an industry standard 19-inch [482.6 mm] equipment mounting rack with EIA universal mounting rail hole spacing.

To mount the D400 on a rack

1. Position the D400 in the rack.
2. Holding the D400 firmly in the rails of the mounting rack, insert and tighten the four rack screws.

   The recommended tool torque settings for zinc-plated mounting screws are:

   - 10-32 UNF screws use 22.2 in-lb [2.50 Nm]
   - 12-24 UNC screws use 31.0 in-lb [3.51 Nm]
   - M5x0.45 screws use 18.1 in-lb [2.04 Nm]
   - M6x0.5 screws use 33.3 in-lb [3.76 Nm]

   For information on wiring the D400, see “Power connections” on page 74.

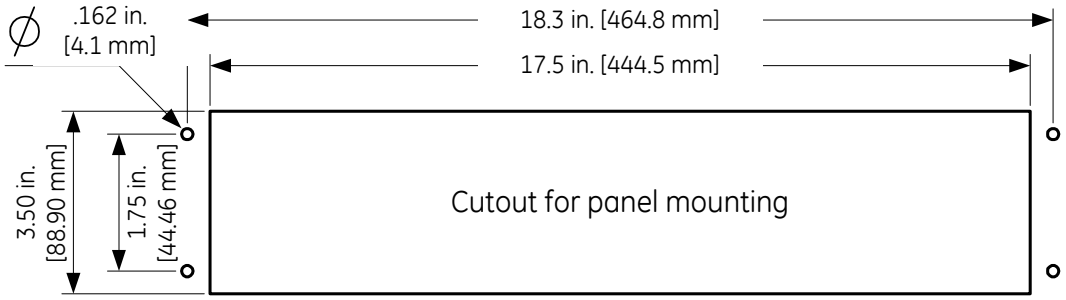
It is not recommended to ship the D400 installed in a rack without support brackets and adequate conductive foam blocking in place.

Panel mount

To mount the D400 in a panel

If you are using a panel cutout, use the following cutout dimensions:

Figure 6: D400 front panel



Battery installation

To insert the Lithium battery

Remove the D400 main module from the chassis and insert the battery in the battery holder **BT1**. See "Replacing the battery" on page 98 for more information.

GE Energy

D400 Substation Gateway

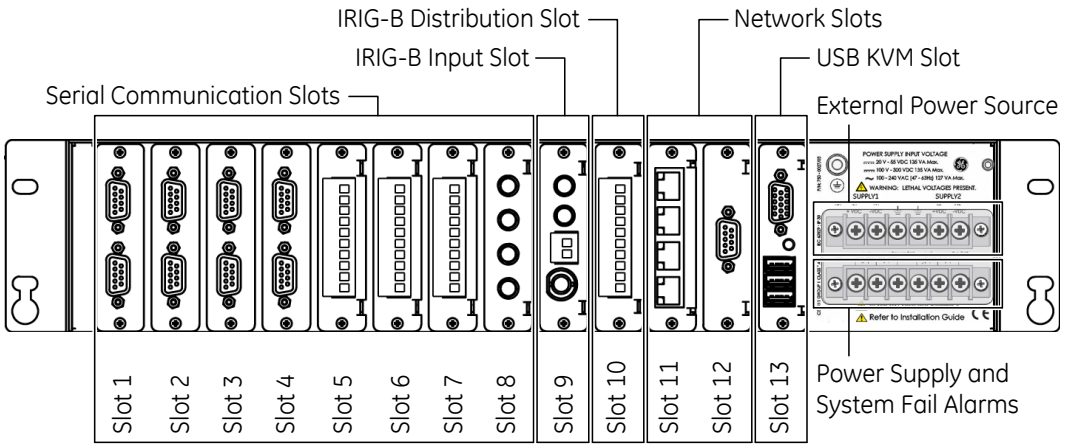
Chapter 3: Setting Up Communication Cards

This chapter describes the D400 communication cards and how to change the card settings for the different configuration options. The communication cards are factory installed in the D400 with default settings.

Communication cards

All communication cards plug into I/O adapter card slots at the rear of the D400 chassis. The communication cards are powered from the backplane of the D400.

Figure 7: D400 I/O adapter card slots



Types of communication cards

The types of communication cards included in your D400 depend on what was ordered for your substation application. The following types of communication cards are available for the D400:

- Serial (Slots 1 to 8)
  - RS-232
  - RS-485
- Fiber Optic Serial (glass or plastic)
  - IRIG-B (Slots 9 and 10)
  - IRIG-B Input
  - IRIG-B Distribution
- Network (Slots 11 and 12)
  - 4-Port Twisted-Pair Ethernet Switch
  - Hot Standby Fiber Optic Ethernet Switch
  - Redundant Twisted-Pair Ethernet + COM2 Port
  - COM2 Port
- USB KVM (Slot 13)
  - Keyboard, Video and Mouse

Changing card settings

The communication cards are factory installed with default settings. You may want to adjust individual card settings to work with your specific system set up. The communication cards are hot swappable -- this means you do *not* have to power down the D400 unit to remove and install the communication cards.

To change the settings on a communication card

1. At the rear panel of the D400, using a flathead or Phillips screwdriver loosen (but don't completely remove) the two screws from the top and bottom of the communication card.
2. Using the flathead screwdriver, gently pry the top of the card from the slot and remove it from the chassis.
3. Refer to the instructions in the following sections to make any required changes to the switch settings on the card.

   Use a small flathead screwdriver (same as used to remove the communication card screws) to change switch positions.
4. Slide the card into the same slot you removed it from, and tighten the two screws.

NOTICE

For proper transient protection, the recommended tool torque settings for communication card screws are 2.6 in-lb [0.294 Nm].

RS-232 adapter

The RS-232 Adapter (GE Item No. 520-0207) is a standard RS-232 serial I/O adapter card that plugs into any serial communication slot (slots 1 through 8) on the D400. It contains two independently isolated RS-232 serial ports (Port 1 **J3** and Port 2 **J2**) each with a DB-9 connector with common shields.

See "RS-232 connections" on page 51 for typical cable connections and connector pin outs.

Configuration options

The RS-232 card supports the following configuration options on each port:

- DCE (Data Communications Equipment)
- DTE (Data Terminal Equipment)
- +5 V (320 mA) output

In addition, the RS-232 card is configurable to optionally provide an IRIG-B signal (on pin 4) and individually isolated Ground (on pin 6).

The signal type and pin options for each port are selectable via two sets of switches on the RS-232 card:

- Port 2 (**J2**) is configured by switches **SW1** and **SW3**
- Port 1 (**J3**) is configured by switches **SW2** and **SW4**

Follow instructions for setting the switches to select the appropriate functions for each port.

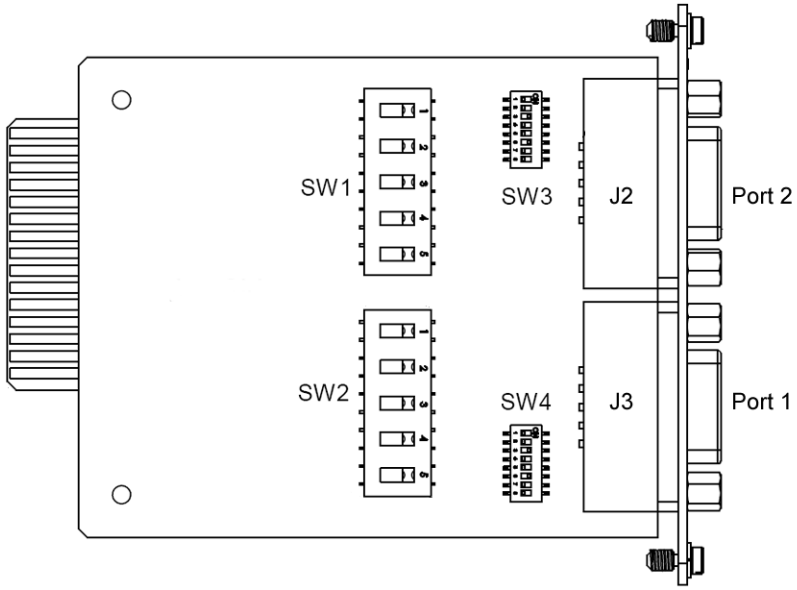
The signal format outputted to the RS-232 cards is dependent upon the format applied to the IRIG-B input adapter:

IRIG-B Input Format...	IRIG-B Output Format...
Pulse Width Modulated (B0xx)	Pulse Width Modulated (B0xx)
Manchester (B2xx)	Manchester (B2xx)
AM Modulated (B1xx)	Pulse Width Modulated (B0xx)

Factory default

The factory default setting is DTE on each port.

Figure 8: RS-232 adapter top side



Switch SW1/SW2 configuration

Switches **SW1** (for Port 2) and **SW2** (for Port 1) control the signal type of the RS-232 port. Each switch contains five switch positions that can each be set to position **A** or **B** to select the appropriate port option.

Table 3: RS-232 Card Switch SW1/SW2 Settings

Port Option	SW1/SW2 Switch Position				
	1	2	3	4	5
DTE (default) - see Figure 9	A	A	A	A	A
DCE - see Figure 10	—	B	B	B	B
+5 V (320 mA) isolated source	B	*	*	*	*

*Use DTE or DCE settings as appropriate

NOTE

DCD output is not supported in DCE mode.

NOTE

Each +5 V output is independently isolated and fused with a PTC (positive temperature coefficient) resettable fuse at 320 mA at 65 °C.

Figure 9: Switch SW1/SW2 configuration for port DTE (default)

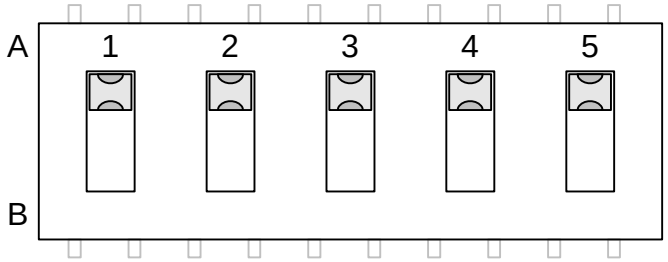
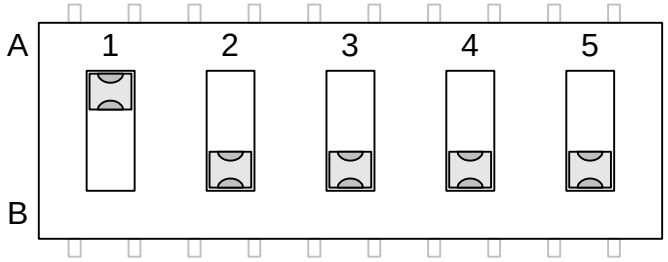


Figure 10: Switch SW1/SW2 configuration for port DCE



Switch SW3/SW4 configuration

Switches **SW3** (for Port 2) and **SW4** (for Port 1) control the signals on Pins 4 and 6 of the RS-232 port. Each switch contains four switch positions that can each be set to **ON** or **OFF** to select the appropriate function for the port option.

Table 4: RS-232 Card Switch SW3/SW4 Settings

Function	Pin 6 Signal	SW3/SW4 Positions				Pin 4 Signal	SW3/SW4 Positions			
		1	2	3	4		5	6	7	8
DTE (default)	DSR Input	OFF	OFF	ON	OFF	DTR Output	OFF	ON	OFF	OFF
DCE	DTR Output	OFF	ON	OFF	OFF	DSR Input	OFF	OFF	ON	OFF
IRIG-B Enable	Ground	OFF	OFF	OFF	ON	IRIG-B Output	ON	OFF	OFF	OFF

The switch positions are listed for:

- DTE (Pin 4 DTR Output to DCE and Pin 6 DSR Input from DCE). See Figure 11.
- DCE (Pin 4 DTR Input from DTE and Pin 6 DSR Output to DTE). See Figure 12.
- IRIG-B Enable (on Pin 4) and Ground (on Pin 6). See Figure 13.

Figure 11: Switch SW3/SW4 configuration for port DTE (default)

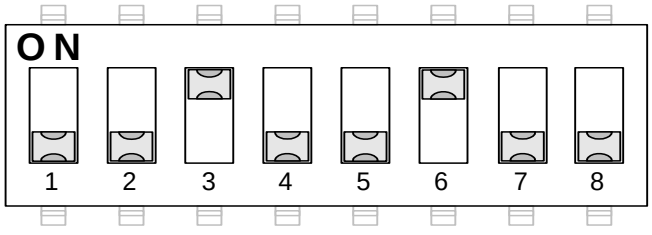


Figure 12: Switch SW3/SW4 configuration for port DCE

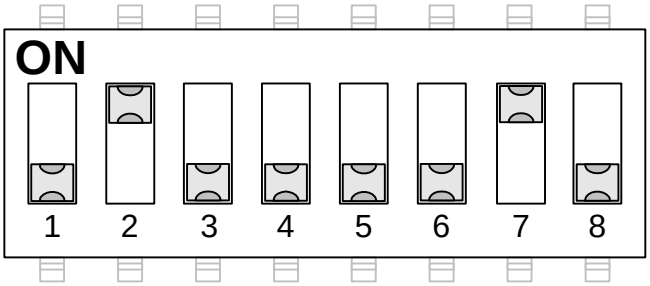
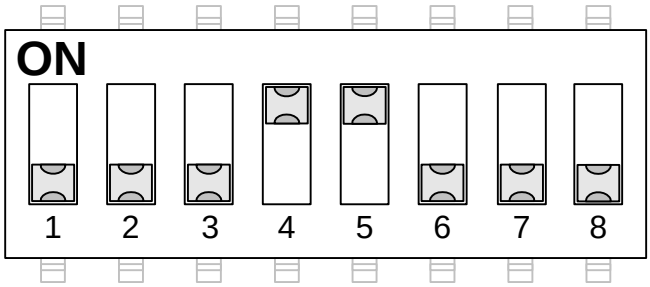


Figure 13: Switch SW3/SW4 configuration for port IRIG-B)



RS-485 adapter

The RS-485 Adapter (GE Item No. 520-0208) plugs into any serial communication slot (slots 1 through 8) on the D400. It contains two independently isolated RS-485 channels on a single terminal block **TB1**: Channel 1 on terminals TB1-1 through TB1-5 and Channel 2 on terminals TB1-6 through TB1-10. TB1 is a 10 position pluggable 5.08 mm pitch connector, Molex P/N 39530-0010 (GE Item No. 640-0955).

See "RS-485 connections" on page 52 for typical cable connections.

Configuration options

The RS-485 card supports two configuration options on each channel:

- 2-wire
- 4-wire

Pull-up/pull-down and line termination selection is available for RS-422 signals.

The signal mode for each channel is selectable via two sets of switches on the RS-485 card:

- Channel 1 (TB1-1 to TB1-5) is configured by switches **SW2** (top side) and **SW4** (bottom side).
- Channel 2 (TB1-6 to TB1-10) is configured by switches **SW1** (top side) and **SW3** (bottom side).

Follow instructions for setting the switches to select the appropriate functions for each channel.

Factory default

The factory default setting is 2-wire on each channel and without RS-422 pull-up/pull-down or line termination resistors selected.

Switch SW1/SW2 configuration

Switches **SW1** (for Channel 2 on TB1-6 through TB1-10) and **SW2** (for Channel 1 on TB1-1 through TB1-5) control the signal mode for each channel. Each switch contains two switch positions that can each be set to **ON** or **OFF** to select the appropriate channel option.

Table 5: RS-485 Card Switch SW1/SW2 Settings

Channel Option	SW1/SW2 Switch Positions	
	1	2
2-Wire (default)	ON	OFF
4-Wire	OFF	ON

Figure 14: RS-485 Adapter Top Side)

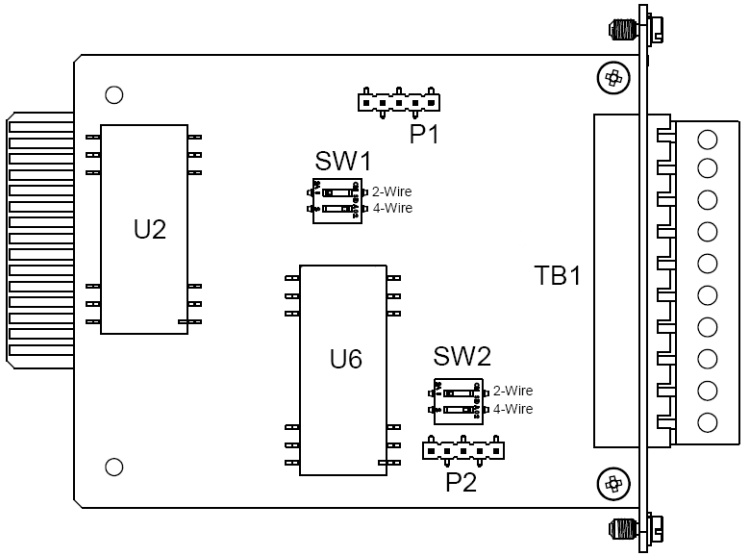
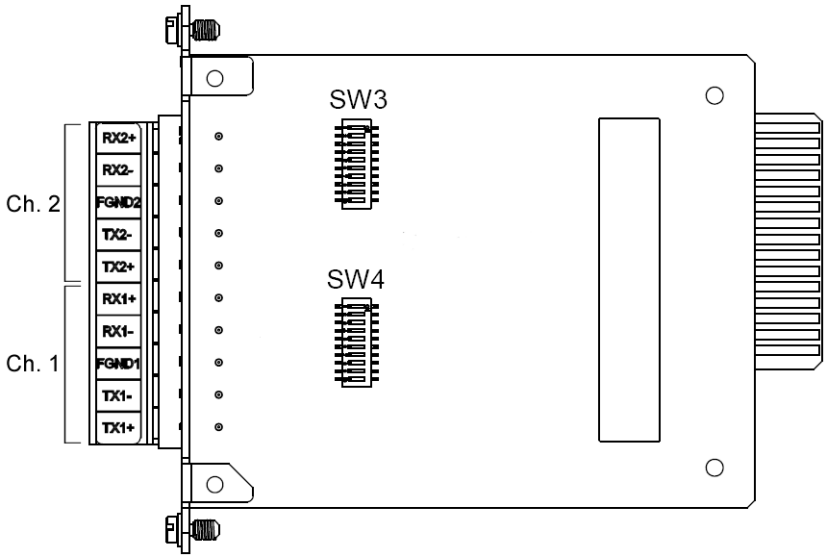


Figure 15: RS-485 Adapter Bottom Side)



Switch SW3/SW4 configuration

Switches **SW3** (for Channel 2 on TB1-6 through TB1-10) and **SW4** (for Channel 1 on TB1-1 through TB1-5) contain ten DIP-switches that control RS-422 pull-up and pull-down resistors for the differential data lines and provide line termination between the differential data pairs. Each DIP-switch can be set to **ON** or **OFF** to select the appropriate function for the switch. That is, if all pins are set to **ON**, switch is ON. If all pins are set to **OFF**, switch is OFF.

If RS-422 termination/pull-up is selected, the TX+ and RX+ signals have a 680 ohm pull-up resistor, the TX- and RX- signals have a 680 ohm pull-down resistor, and the RX and TX signals have a 120 ohm termination.

Figure 16: RS-485 Mode - 12 KOhm (Single Unit Load))

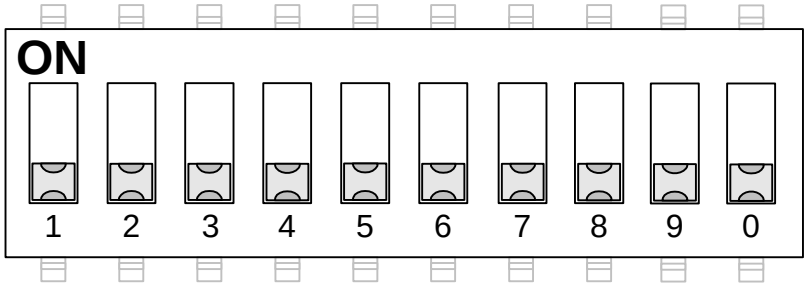


Figure 17: RS-422 120 Ohm Line Termination on TX and RX

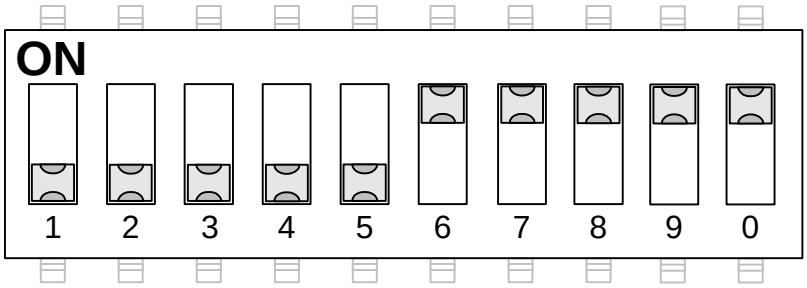
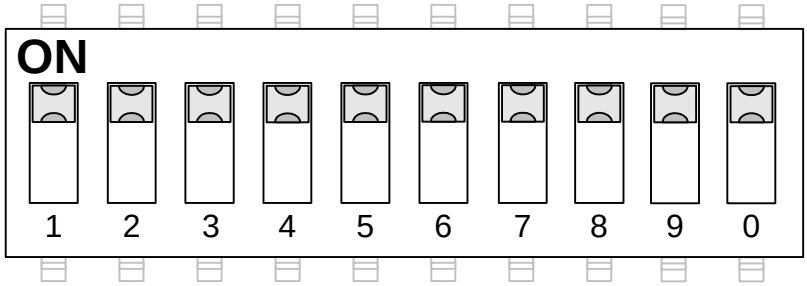


Figure 18: RS-422 120 Ohm Line Termination with 680 Ohm Pull-Up and Pull-Down Resistors



Fiber optic serial adapter

The Fiber Optic Serial Adapter is available in two variants:

- Glass Optical Fiber (GOF) Serial with 820-850 nm ST connectors (GE Item No. 520-0209)
- Plastic Optical Fiber (POF) Serial with 660 nm Agilent Versatile Link connectors (GE Item No. 520-0210)

NOTE

The plastic optical fiber is limited to 38.4 kbps operation and a lower operating temperature limit of 0 °C.

The Fiber Optic Serial cards include two pairs of channels for signal transmission (TX1/TX2) and reception (RX1/RX2) through ST (GOF) or Versatile Link (POF) connectors. The cards plug into any serial communication slot (slots 1 through 8) on the D400.

Configuration options

The Fiber Optic Serial card supports the following configuration options for each channel:

- Standard state
- Inverted state

The state for each channel is selectable via a single two-position pin switch **SW1** on the Fiber Optic Serial card.

Follow instructions for setting the switch to select the appropriate state for each channel.

NOTE

The fiber optic channel settings on the D400 must match the set up of the other end of the fiber optic communications channel.

Factory default

The factory default setting is **Standard** state on each channel.

Switch SW1 configuration

Switch **SW1** controls the state of each fiber optic channel. The switch contains four two-position pins that can each be set to **A** or **B** to select the appropriate state.

Table 6: Fiber Optic Serial Card Switch SW1 Settings

State Option	SW1 Switch Position			
	1	2	3	4
Standard (default)	B	A	B	A
Inverted	A	B	A	B

NOTE

In Standard state fiber is lit when a “1” is transmitted. In Inverted state fiber is lit when a “0” is transmitted.

Figure 19: Glass Optical Fiber Serial Adapter

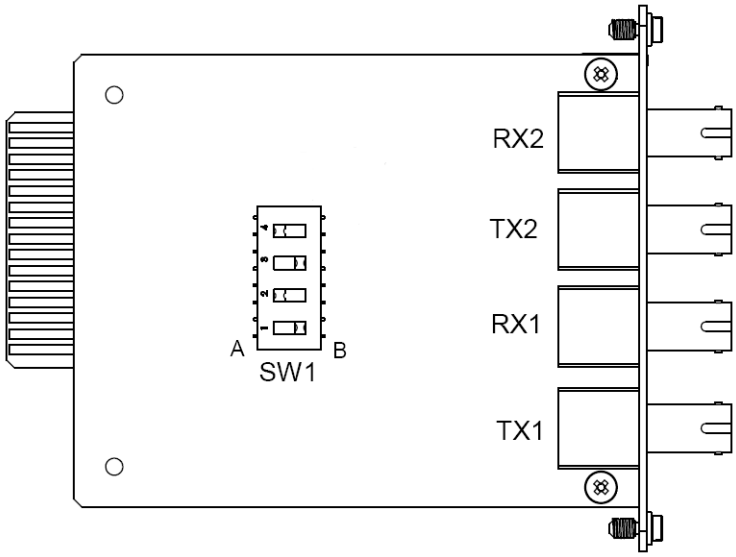
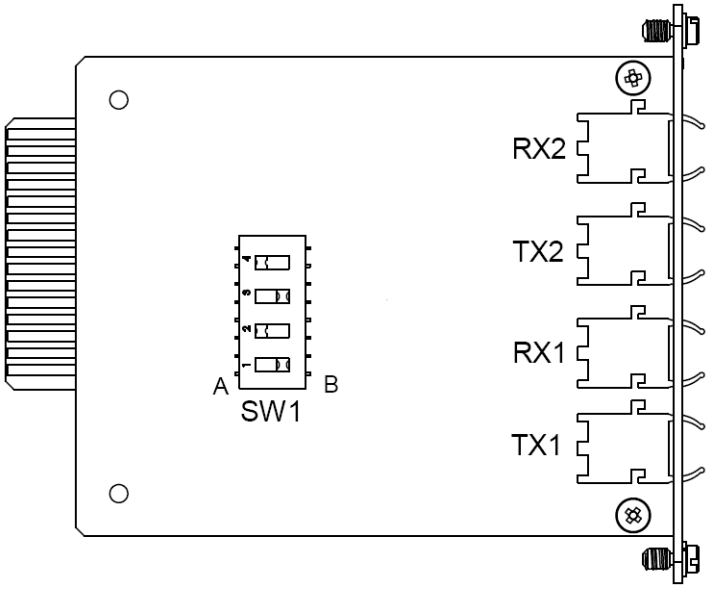


Figure 20: Plastic Optical Fiber Serial Adapter



IRIG-B input adapter

The IRIG-B Input Adapter (GE Item No. 520-0211) plugs into a dedicated IRIG-B slot (slot 9) on the D400. The IRIG-B Input card accepts an IRIG-B signal in one of three input formats through a corresponding connector type:

- Modulated IRIG-B through a **BNC** connector **J2**
  AM modulated input accepts B12X, however, the SBS (straight binary seconds) in B120, B124, and B127 are decoded but not used to set the time

- Pulse Width Code IRIG-B (**TTL**) through a terminal block **TB1**
  (TTL) input accepts B00X and B237, however, the SBS field is decoded but not used to set the time. The connector used is a 2 position pluggable terminal block, Molex P/N 39530-0002 (GE Part No. 640-0956)
- Fiber Optic through a Receive (**RX)** 820 to 850 nm ST connector **U12**

The IRIG-B signal (TTL) can be subsequently distributed to attached devices through one of the following options:

- IRIG-B Distribution Adapter (GE Item No. 520-0212). See "IRIG-B distribution adapter" on page 42.
- RS-232 Adapter (GE Item No. 520-0207). See "IRIG-B input adapter" on page 39.

See "IRIG-B connections" on page 56 for wiring instructions.

J2	**Input Range**	4.0 V_{P-P} to 8.0 V_{P-P}; No DC offset
	Input Impedance	>1 MΩ @ 1 kHz
TB1	**Voltage Range**	High: > 3.5 V Low: < 1.5 V
	Load	One HCMOS load
U12	**Receiver Sensitivity**	–25.4 dBm

Configuration options

The input signal formats and output options are selectable via three switches on the IRIG-B Input card:

- IRIG-B state option is configured by switch **SW1**
- Input signal format is configured by switch **SW2**
- Fiber optic TX option is configured by switch **SW3**

Follow instructions for setting the switches to select the appropriate IRIG-B signal formats and functions.

Factory default

The factory default setting is the Standard state on each channel.

Switch SW1 configuration

Switch **SW1** controls the state option for the IRIG-B Input card. It contains two switch positions that can be set to **ON** or **OFF** to select the appropriate IRIG-B state option.

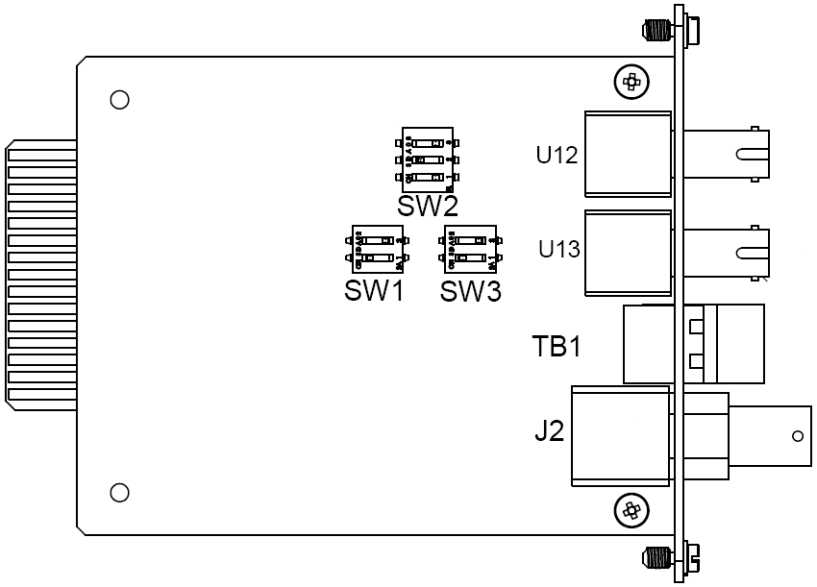
Table 7: IRIG-B Input Card Switch SW1 Settings

IRIG-B State Option	**SW1 Switch Positions**	
	1	2
Standard (default)	ON	OFF
Fiber TX Continuous Test Mode	OFF	ON

NOTE

Leave switch **SW1** in the Standard position as it is required for the D400 to properly decode and set the system time.

Figure 21: IRIG-B Input Adapter



Switch SW2 configuration

Switch **SW2** controls the signal option for the selected state option (SW1). It contains three switch positions that can be set to **ON** or **OFF** to select the appropriate signal.

Table 8: IRIG-B Input Card Switch SW2 Settings

Input Signal Option	SW2 Switch Positions		
	1	2	3
Fiber Optic (RX)	ON	OFF	OFF
TTL (TB1) (default)	OFF	ON	OFF
BNC (J2)	OFF	OFF	ON

Switch SW3 configuration

Switch **SW3** controls the state option for the IRIG-B fiber optic TX input. It contains two switch positions that can be set to **ON** or **OFF** to select the appropriate state.

Table 9: IRIG-B Input Card Switch SW3 Settings

Fiber Optic TX Option	SW3 Switch Positions	
	1	2
Fiber RX (default)	ON	OFF
Inverted (Fiber TX)	OFF	ON

NOTE

To drive the Fiber TX mode, the Fiber Optic (RX) must be set as the Input Signal option on SW2.

IRIG-B distribution adapter

The IRIG-B Distribution Adapter (GE Item No. 520-0212) is an optional IRIG-B output card to supply a pulse width coded IRIG-B (TTL) signal passed from the IRIG-B Input card to attached devices. The IRIG-B Distribution card provides four channels on a single terminal block. Each channel is capable of supplying a signal to up to four devices, for a total of 16 devices. The IRIG-B Distribution card plugs into a dedicated IRIG-B slot (slot 10) on the D400.

Output Voltage

Output as per advanced HCMOS duty cycle may vary up to ±10% from nominal when the AM modulation option is used. The connector used is a 10 position, 5.08 mm pitch pluggable connector, Molex part number 39530-0010 (GE Item No. 640-0955).

See “IRIG-B connections” on page 56 for wiring instructions.

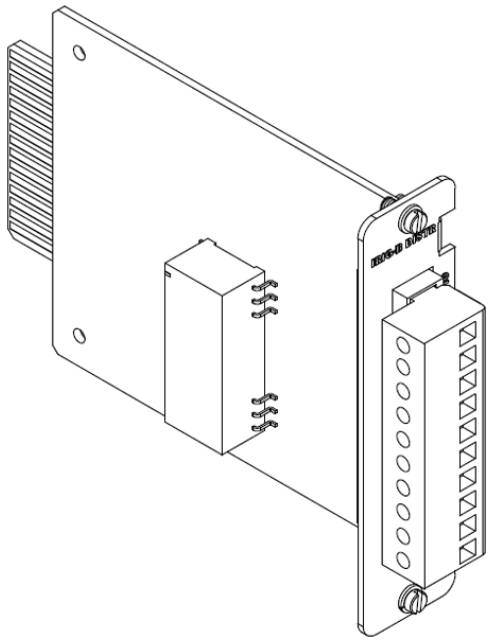
Configuration options

There are no selectable options on the IRIG-B Distribution card.

The signal format outputted to the IRIG-B distribution adapter is dependent upon the format applied to the IRIG-B input adapter:

IRIG-B Input Format...	IRIG-B Output Format...
Pulse Width Modulated (B0xx)	Pulse Width Modulated (B0xx)
Manchester (B2xx)	Manchester (B2xx)
AM Modulated (B1xx)	Pulse Width Modulated (B0xx)

Figure 22: IRIG-B Distribution Adapter



4-Port twisted-pair ethernet switch

The 4-Port Twisted-Pair Ethernet Switch (GE Item No. 520-0213) is a 10/100BaseT network switch that plugs into the NET1 slot (slot 11) on the D400. It provides local area network connections for up to five Ethernet connections: four RJ-45 connectors on the rear panel and one RJ-45 connector on the front panel. The connector used is four RJ-45 connectors ganged together. The data rate is automatically detected and set to either 10 Mbps or 100 Mbps.

A second Ethernet switch can be installed in the NET2 slot (slot 12). If two Ethernet switches are installed in the NET slots, the D400 may be used in a dual-IP redundancy mode. That is, each switch can be configured with a different IP address to provide a backup network connection if the primary channel fails. Use of this card in slot 12 requires installation of the dual redundant Ethernet CPU option which includes the PC/104-Plus 10/100BasetT Ethernet Module and cable (GE item 580-3410 & 977-0544).

See “Network connections” on page 59 for typical cable connections.

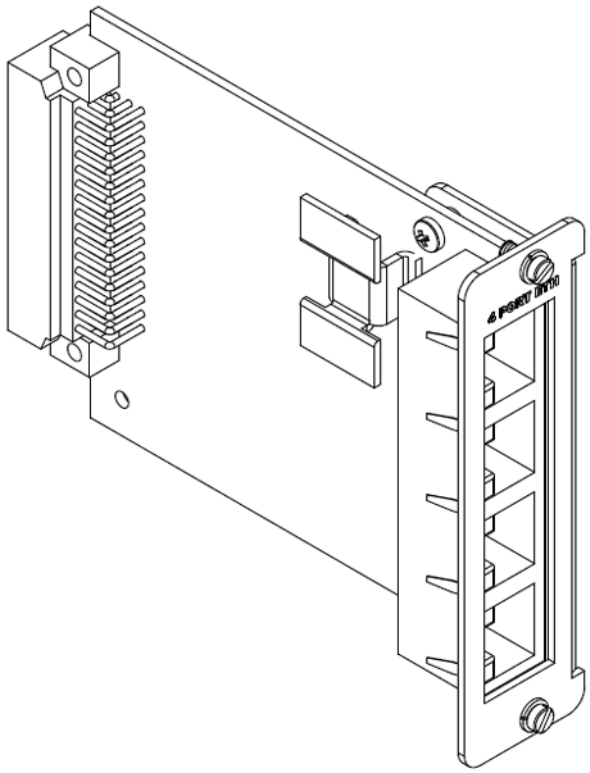
TIP

If additional ports are required, two Ethernet switches can be connected to each other with an Ethernet cable. This will increase the number of available 10/100BaseT ports to 6.

Configuration options

There are no selectable options on the 4-Port TP Ethernet card.

Figure 23: 4-Port Twisted-Pair Ethernet Switch Card



10Base-FL hot standby fiber optic ethernet switch

The Hot Standby Fiber Optic Ethernet Switch (GE Item No. 520-0214) is a 10BaseFL/100BaseSX (820 to 850 nm) network switch that supports single-IP redundancy for the D400. It provides automated fail over between two Ethernet fiber optic network connections (**RX1/TX1** and **RX2/TX2**) that share a single MAC address.

When the primary port (Fiber Optic Channel 1) receives no signal, or detects a fault signal from the remote link partner, the D400 switches to the secondary port (Fiber Optic Channel 2) if it has a valid link. The D400 reverts to the primary port if the primary link is restored or no signal is present on the secondary port. The data rate on each port is independently detected and set to 10 Mbps or 100 Mbps.

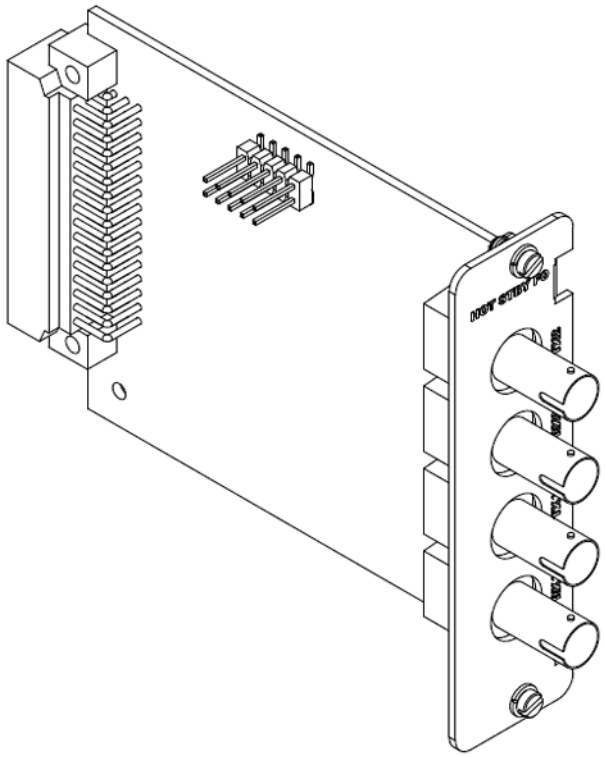
The Hot Standby Fiber Optic Ethernet Switch can be installed in the NET1 or NET2 slot (slots 11 and 12) on the D400. Use of this card in slot 12 requires installation of the dual redundant Ethernet CPU option which includes the PC/104-Plus 10/100BasetT Ethernet Module and cable (GE item 580-3410 & 977-0544)

See “Fiber optic serial connections” on page 55 for typical cable connections.

Configuration options

There are no selectable options on the Hot Standby Fiber Optic Ethernet Switch card.

Figure 24: Hot Standby Fiber Optic Ethernet Switch Card



100Base-FX hot standby fiber optic ethernet adapter

The 100Base-FX Hot Standby Fiber Optic Ethernet Adapter (GE Item No. 520-0215) is a 100Base-FX (1300 nm) network switch that supports single-IP redundancy for the D400. It provides automated fail over between two Ethernet fiber optic network connections (**RX1/TX1** and **RX2/TX2**) that share a single MAC address.

When the primary port (Fiber Optic Channel 1) receives no signal, or detects a fault signal from the remote link partner, the D400 switches to the secondary port (Fiber Optic Channel 2) if it has a valid link. The D400 reverts to the primary port if the primary link is restored or no signal is present on the secondary port. The data rate on each port is 100 Mbps.

The Hot Standby Fiber Optic Ethernet Switch can be installed in the NET1 or NET2 slot (slots 11 and 12) on the D400. Use of this card in slot 12 requires installation of the dual redundant Ethernet CPU option which includes the PC/104-Plus 10/100BasetT Ethernet Module and cable (GE item 580-3410 & 977-0544).

See "Fiber optic serial connections" on page 55 for typical cable connections.

NOTE

You must enable Far End Fault Indication (FEFI) or Loss Link Alert (LLA) in connected external devices for proper redundant operation.

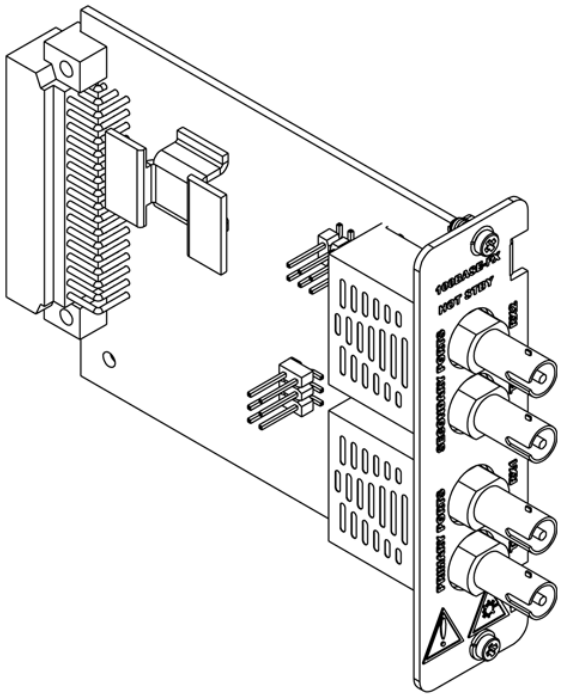
NOTE

External switches must have Spanning Tree Protocol port settings configured to **edge** for proper operation of 100Base-FX connected ports.

Configuration options

There are no selectable options on the 100Base-FX Hot Standby Fiber Optic Ethernet Adapter card.

Figure 25: 100Base-FX Hot Standby Fiber Optic Ethernet Adapter Card



COM2 port adapter

The COM2 Port Adapter (GE Item No. 520-0219) provides a single DB-9 connector (**P2**) wired for an RS-232 DCE signal. The COM2 Port card can support serial connections for the following dial-up interfaces:

- External modem
- Point-to-point protocol (PPP) services
- Wide area network

The COM2 Port Adapter plugs into any NET slot (slots 11 and 12) of the D400.

NOTE

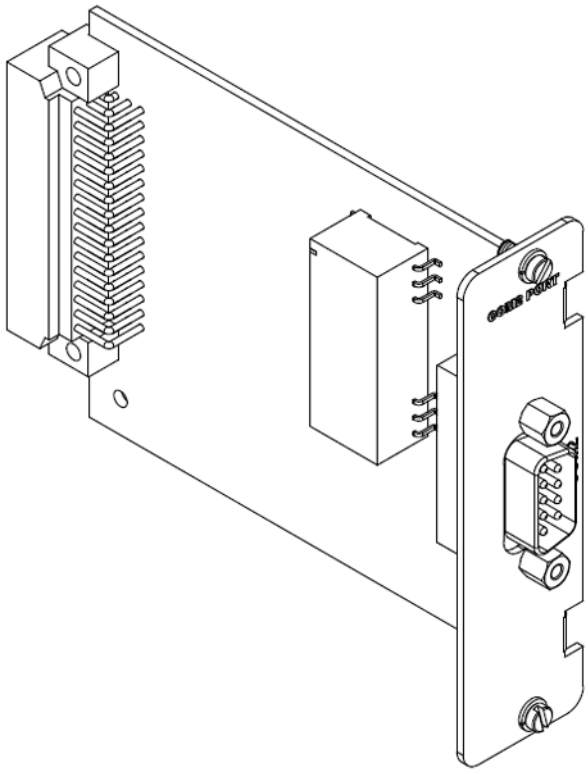
The COM2 Port requires an external modem to provide dial-up functionality.

See “Modem connections” on page 61 for typical cable connections.

Configuration options

There are no selectable options on the COM2 Port card.

Figure 26: COM2 Port Adapter



Redundant twisted-pair ethernet + COM2 port adapter

The Redundant TP Ethernet + COM2 Port card (GE Item No. 520-0218) provides two local area network connections with unique MAC addresses through Ethernet RJ-45 connectors. The **LAN** input routes to a three-port Ethernet switch and the **WAN** input routes to the PC/104-Plus Ethernet Module. The Ethernet switch can support a dual-redundancy network option on the D400. The data rate on each LAN or WAN port is independently detected and set to either 10 Mbps or 100 Mbps. The card also provides an RS-232 DCE connection through a DB-9 connector. The Redundant TP Ethernet + COM2 Port card can only be installed in the NET1 slot (slot 11) on the D400.

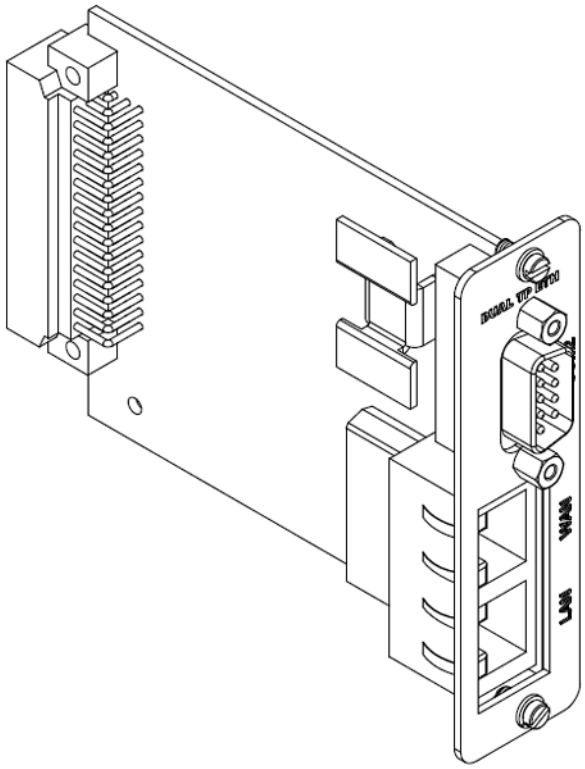
Note: Use of the Redundant TP Ethernet + COM2 Port card requires the installation of the dual redundant Ethernet D400 CPU option, which includes the PC/104-Plus 10/100BasetT Ethernet Module and cable (GE item 580-3410 & 977-0544). The COM2 Port requires an external modem to provide dial-up functionality.

See “Network connections” on page 59 and “Modem connections” on page 61 for typical cable connections.

Configuration options

There are no selectable options on the Redundant TP Ethernet + COM2 Port card.

Figure 27: Redundant TP Ethernet + COM2 Port Adapter Card



USB KVM and audio adapter

The USB Keyboard, Video, Mouse Adapter (GE Item No. 520-0206) plugs into the USB KVM slot (slot 13) on the D400. The card provides connections for setting up a permanent local workstation, including:

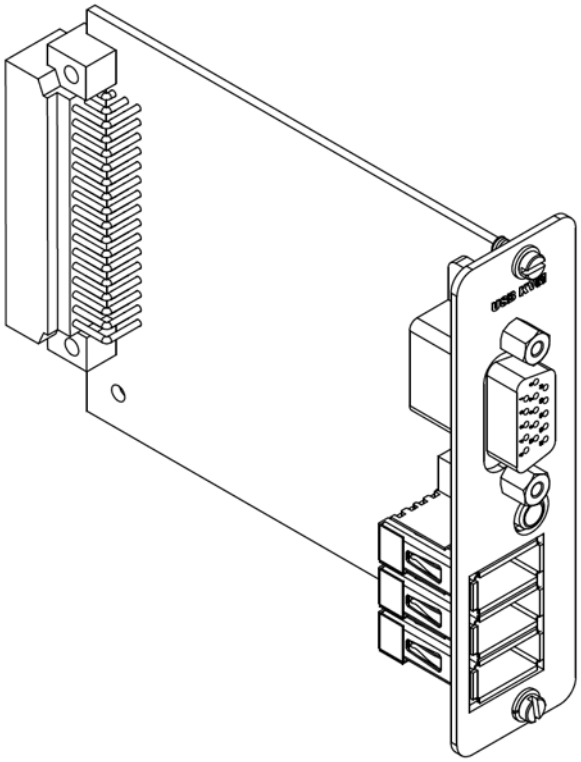
- Three USB v1.1 compliant Type A ports (**P3**-**P5**) for keyboard, mouse or other USB device
- Single 3.5 mm audio jack (**P2**) for stereo audio output
- High-density D-sub 15-socket connector (**J1**) for video output

See "Local HMI connection" on page 62 for typical cable connections.

Configuration options

There are no selectable options on the USB KVM card.

Figure 28: USB KVM Adapter



GE Energy

D400 Substation Gateway

Chapter 4: Connecting to Devices and Networks

This chapter provides guidelines for making physical connections between the D400 and substation and network devices.

Connection types

The D400 can accommodate a wide range of devices and network connections through a variety of communication card options.

For more information about the types of communication cards and configuration options, see Chapter 3, *Setting Up Communication Cards*.

Serial

The D400 can support up to 16 serial connections (up to 8 serial adapter cards with 2 ports each) to a variety of GE and other vendor devices, including:

- Protective relays
- Meters
- Programmable logic controllers (PLCs)
- Remote terminal units (RTUs)
- Monitoring equipment
- Digital fault recorders (DFRs)
- Sequence of event (SOE) recorders
- Load tap changers (LTCs)

The following types of serial connections are supported in single or multi-dropped set ups:

- RS-232
- RS-485 (2-wire or 4-wire)
- Fiber Optic Serial (glass or plastic)

Network

The D400 can support up to eight network connections to host and network clients, including:

- SCADA master station
- Substation LAN
- Enterprise network (Corporate wide area network). The following networking connections are supported:
  - Ethernet (Twisted pair or Fiber optic)
  - COM2 (for dial-up)

Time synchronization

The D400 accepts a time synchronization input (IRIG-B format) from GPS receivers that can be subsequently distributed to connected devices.

Local substation computer

A substation computer can be set up with the D400 through the USB KVM connections to access the local HMI.

Optionally, a portable PC can be connected to the front Ethernet port to access the HMI.

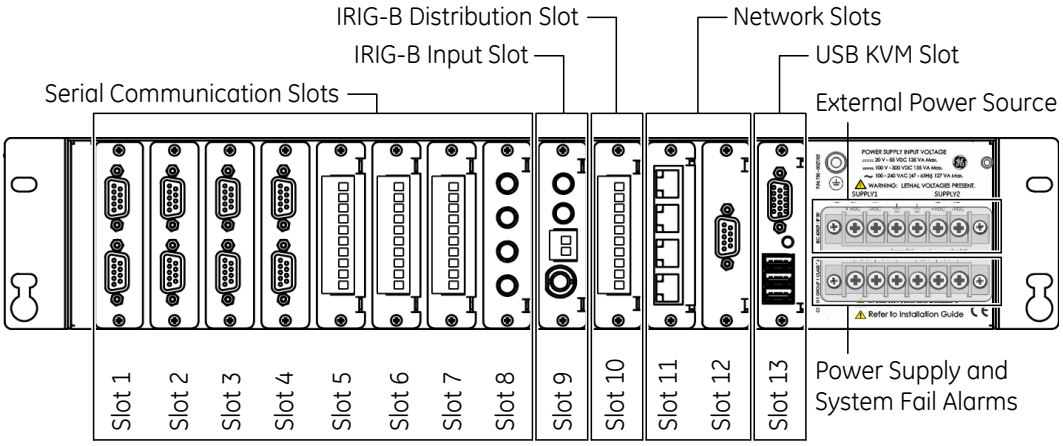
Local maintenance

A local PC can be directly connected to the D400 through the front serial communications port to perform system maintenance using the D400 System Utilities.

Cabling overview

The D400 provides a series of I/O adapter cards for connecting cables and wiring from substation devices and network interfaces. All physical connections are made to easily accessible connectors on the rear panel of the D400.

Figure 29: D400 Field and Network Connections



The types of communication cards included in your D400 depend on what was ordered for your substation application.

For a list and detailed description of the types of communication cards available, see Chapter 3, *Setting Up Communication Cards*.

General cabling requirements

Cabling required to make physical connections to the D400 are as follows:

Media	Designation	Cabling	Connector
Fiber Optic Ethernet	10BaseFL 100BaseFX	62.5/125 µm or 50/125 µm multi-mode fiber cable	ST Connectors (820 to 850 nm)
Twisted Pair Ethernet	10/100BaseT	UTP– Unshielded Twisted Pair – CAT 5 or better	RJ-45
Redundant Twisted Pair Ethernet	10/100BaseT	UTP– Unshielded Twisted Pair – CAT 5 or better	RJ-45
PPP Serial Over External Modem	RS-232	Standard RS-232 cable	DB-9

High-voltage installations

To provide higher EMC immunity and maintain CE Mark compliance, the serial cables used for permanent RS-232 and RS-485 connections must comply with the following requirements:

- Cables must be shielded
- D-type connector covers must provide EMC shielding (e.g. metallized plastic or die cast metal covers).

RS-232 connections

The D400 accepts connections to RS-232 type devices through the RS-232 Adapter. The RS-232 Adapter (GE Item No. 520-0207) is an RS-232 serial I/O adapter card that plugs into any serial communication slot (slots 1 through 8) on the D400. It contains two independently isolated RS-232 serial ports (**Port 1** and **Port 2**) each with a DB-9 connector.

The required RS-232 cable is a serial null modem, DB-9F to DB-9M cable. The cables must be shielded and DB-9S connector covers must provide EMC shielding (e.g. metallized plastic or die-cast metal covers).

See "RS-232 adapter" on page 31 for configuration options.

To connect RS-232 type devices to the RS-232 adapter

Use the cable connection shown in Figure 30

Figure 30: RS-232 cable connection

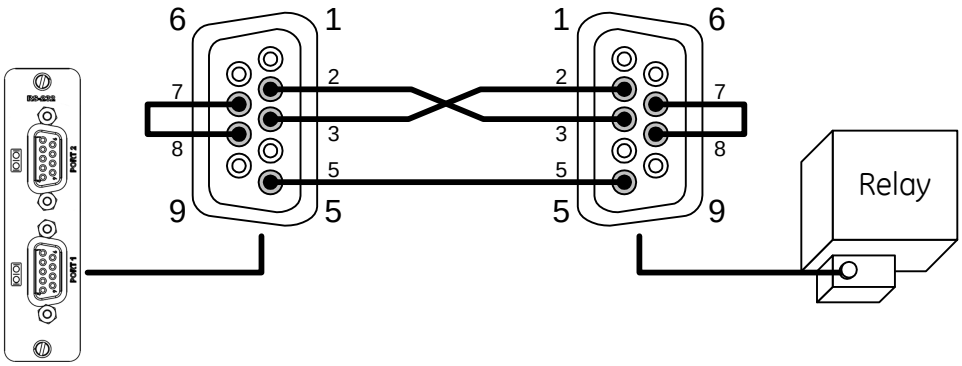


Table 10: RS-232 Port DB-9 Connector Signal Definitions

Pin Numbers	DTE (default)		DCE	
	Signal Acronym	Signal Flow	Signal Acronym	Signal Flow
1	DCD	IN from DCE	a	a
2	RXD	IN from DCE	RXD	OUT to DTE
3	TXD	OUT to DCE	TXD	IN from DTE
4	DTR	OUT to DCE	DTR	IN from DTE
5	Signal GND	-	Signal GND	-
6	DSR	IN from DCE	DSR	OUT to DTE
7	RTS	OUT to DCE	RTS	IN from DTE
8	CTS	IN from DCE	CTS	OUT to DTE
9	Not connected	-	Not connected	-

[a] DCD output not supported in DCE mode.

RS-485 connections

The D400 accepts connections to RS-485 2-wire and 4-wire type devices through the RS-485 Adapter. The RS-485 Adapter (GE Item No. 520-0208) plugs into any serial communication slot (slots 1 through 8) on the D400. It contains two independently isolated RS-485 channels on a single terminal block: Channel 1 on terminals TB1-1 through TB1-5 and Channel 2 on terminals TB1-6 through TB1-10. Terminal blocks accept a range of 24-14 AWG [0.2-2.1 mm²] Recommended wire strip length is 0.2" [5.0 mm]. Screws shall be torqued with tool setting of 4.2 in-lb [0.46 Nm]. A 3.0 to 3.5 mm flat screwdriver tip is recommended.

The transceiver in 2-wire mode and the receiver in 4-wire mode present 1 unit load (UL), nominally 12 KOhm, to the external network with switches SW3/SW4 all off.

See “RS-485 adapter” on page 35 for configuration options.

Cabling requirements

The recommended total maximum length for RS-485 cables is 4000 ft [1300 m] when operating at 115 kbps. Refer to the manual of the connecting device for its recommended maximum cable length.

The cables must be shielded and the shield of each RS-485 cable section should be grounded at one end only. This prevents circulating currents and can reduce surge-induced current on long communication lines.

The RS-485 Adapter supports a maximum of 32 transceivers of standard unit load per channel (64 unit loads per RS-485 Adapter card).

2-Wire connections

To connect RS-485 2-wire type devices to the RS-485 Adapter

Use the following wiring connection:

NOTE

Before wiring devices, ensure that the RS-485 Adapter is configured to 2-wire mode (see “RS-485 adapter” on page 35).

Figure 31: RS-485 2-wire devices - wiring connection

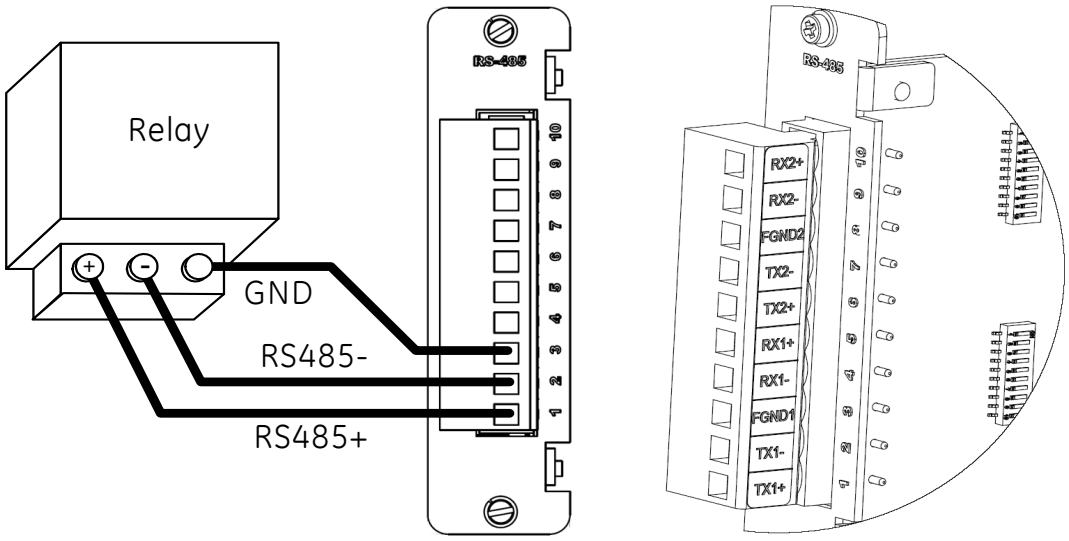


Table 11: RS-485 2-Wire Terminal Block Signal Definitions

RS-485 Channel	Position Number	2-Wire	
		Function	Signal Flow
Channel 1	1	TX1+	IN/OUT
	2	TX1–	IN/OUT
	3	FGND 1	Shield
	4	RX1–	-
	5	RX1+	-

RS-485 Channel	Position Number	2-Wire	
		Function	Signal Flow
Channel 2	6	TX2+	IN/OUT
	7	TX2–	IN/OUT
	8	FGND 2	Shield
	9	RX2–	-
	10	RX2+	-

NOTE

The terminal block positions are numbered from 1 to 10 starting from the bottom of the card.

4-Wire connections

See “RS-485 adapter” on page 35 for configuration options.

To connect RS-485 4-wire type devices to the RS-485 Adapter

Use the following wiring connection:

NOTE

Before wiring devices, ensure that the RS-485 Adapter is configured to 4-wire mode (see “RS-485 adapter” on page 35).

Figure 32: RS-485 4-wire devices - wiring connection

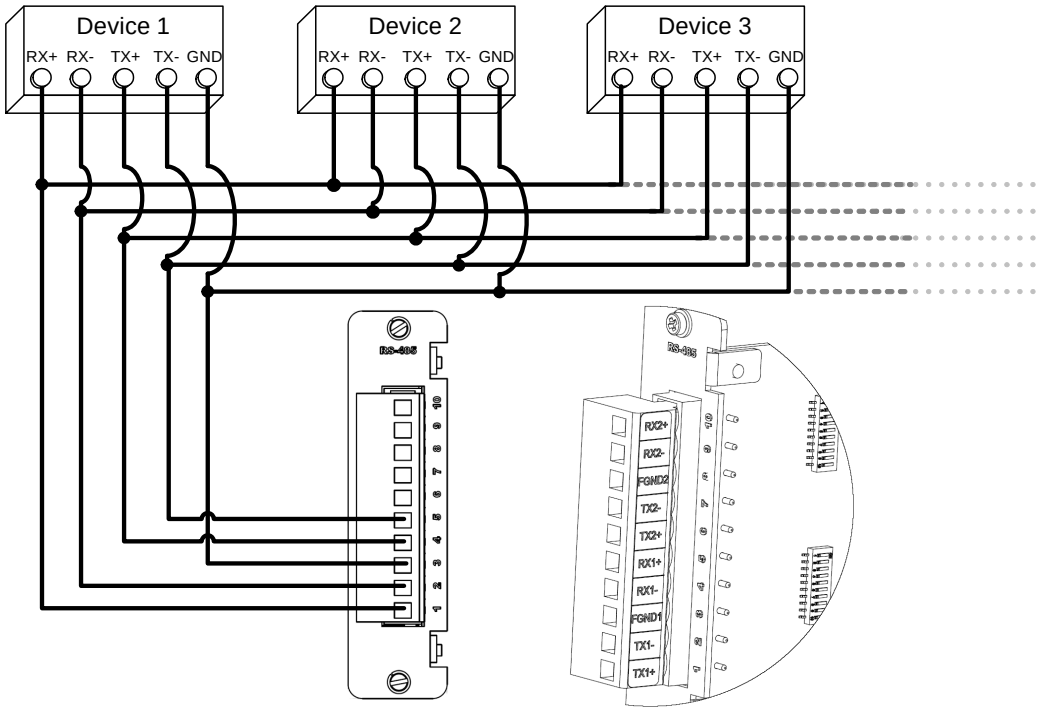


Table 12: RS-485 4-Wire Terminal Block Signal Definitions

RS-485 Channel	Position Number	4-Wire (default)	
		Function	Signal Flow
Channel 1	1	TX1+	OUT
	2	TX1–	OUT
	3	FGND 1	Shield
	4	RX1–	IN
	5	RX1+	IN
Channel 2	6	TX2+	OUT
	7	TX2–	OUT
	8	FGND 2	Shield
	9	RX2–	IN
	10	RX2+	IN

NOTE

The terminal block positions are numbered from 1 to 10 starting from the bottom of the card.

Fiber optic serial connections

For devices located some distance from the D400, they may be connected using glass or plastic optical fiber cables. Fiber optic cabling also offers superior performance in electrically noisy environments.

Glass optical fiber

You can use the following glass optical fiber (GOF) cabling with the D400 Glass Optical Fiber Serial adapter:

- 50/125 µm core/cladding multi-mode (gradient index) cable
- 62.5/125 µm core cladding multi-mode (gradient index) cable
- 100/140 µm core/cladding multi-mode (gradient index) cable
- 200 m core Hard-Clad Silica (HCS) multi-mode (step index) cable

You can use the following fiber optic terminations for D400 cabling:

- ST Connectors

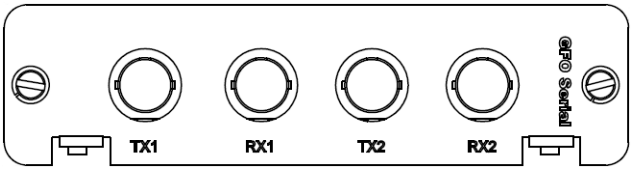
When calculating cable length, consider the following optical power levels:

- Glass optical fiber transmitter power is –19.0 ± 2 dBm
- Glass optical fiber receiver sensitivity is typically –25.4 dBm

⚠CAUTION

LED transmitters are classified as IEC 60825-1 Accessible Emission Limit (AEL) Class 1M. Class 1M devices are considered eye safe to the unaided eye. Do not view directly with optical instruments.

Figure 33: D400 Glass Optical Fiber Serial adapter



Plastic optical fiber

You can use 1 mm plastic optical fiber (POF) cabling with the D400 Plastic Optical Fiber Serial adapter. The recommended termination is the Agilent Versatile Link Simplex Connector.

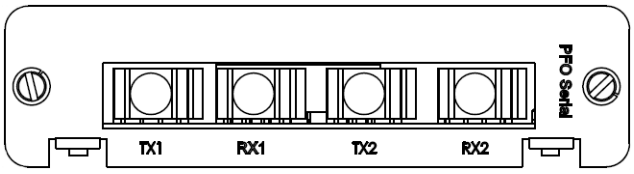
When calculating cable length, consider the following optical power levels:

- Plastic optical fiber transmitter power is –9.0 ± 4.5 dBm
- Plastic optical fiber receiver sensitivity is typically –39 dBm

⚠CAUTION

LED transmitters are classified as IEC 60825-1 Accessible Emission Limit (AEL) Class 1M. Class 1M devices are considered eye safe to the unaided eye. Do not view directly with optical instruments.

Figure 34: D400 Plastic Optical Fiber Serial adapter



NOTE

It is possible to saturate the receiver input if the cable used is too short. Inline attenuation may be required.

See “Fiber optic serial adapter” on page 38 for configuration options.

To connect fiber optic links to the Fiber Optic adapters

Plug fiber optic cables into the corresponding TX and RX connectors.

IRIG-B connections

The D400 uses a pair of IRIG-B adapter cards, the IRIG-B Input Adapter and the IRIG-B Distribution Adapter, to accept an IRIG-B signal from a GPS receiver then distribute the signal to connected IEDs.

See “IRIG-B input adapter” on page 39 and “IRIG-B distribution adapter” on page 42 for more information.

IRIG-B input adapter

The IRIG-B Input Adapter (GE Item No. 520-0211) plugs into a dedicated IRIG-B slot (slot 9) on the D400. The IRIG-B Input card accepts an IRIG-B signal in one of three input formats through a corresponding connector type:

- Modulated IRIG-B through a BNC connector
- Pulse width coded IRIG-B (**TTL**) through a terminal block
- Fiber Optic through a Receive (**RX**) 820-850 nm ST connector

Terminal blocks accept a range of 24 to 14 AWG [0.2 to 2.1 mm²] Recommended wire strip length is 0.2" [5.0 mm]. Screws shall be torqued with tool setting of 4.2 in-lb [0.46 Nm]. A 3.0 to 3.5 mm flat screwdriver tip is recommended.

You can use the following glass optical fiber (GOF) cabling with the D400 Glass Optical Fiber Serial adapter:

- 50/125 µm core/cladding multi-mode (gradient index) cable
- 62.5/125 µm core cladding multi-mode (gradient index) cable
- 100/140 µm core/cladding multi-mode (gradient index) cable
- 200 m core Hard-Clad Silica (HCS) multi-mode (step index) cable

You can use the following fiber optic terminations for D400 cabling:

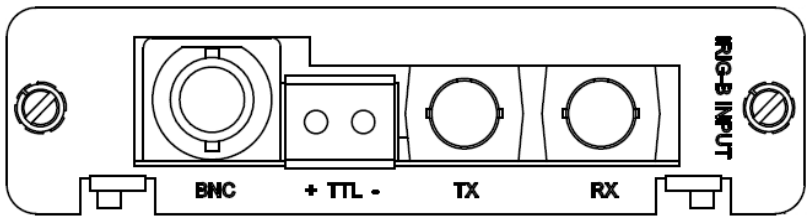
- ST Connectors

When calculating cable length, consider the following optical power levels:

- Glass optical fiber receiver sensitivity is typically –25.4 dBm

⚠CAUTION **LED transmitters are classified as IEC 60825-1 Accessible Emission Limit (AEL) Class 1M. Class 1M devices are considered eye safe to the unaided eye. Do not view directly with optical instruments.**

Figure 35: IRIG-B Input Adapter



IRIG-B distribution adapter

The IRIG-B Distribution Adapter (GE Item No. 520-0212) is an optional IRIG-B output card to supply a pulse width coded IRIG-B (TTL) signal passed from the IRIG-B Input card to attached IEDs. The IRIG-B Distribution card provides four channels on a single terminal block. Each channel is capable of supplying a signal to up to four IEDs, for a total of 16 IEDs. The IRIG-B Distribution card plugs into a dedicated IRIG-B slot (slot 10) on the D400.

Terminal blocks accept a range of 24 to 14 AWG [0.2 to 2.1 mm²] Recommended wire strip length is 0.2" [5.0 mm]. Screws shall be torqued with tool setting of 4.2 in-lb [0.46 Nm]. A 3.0 to 3.5 mm flat screwdriver tip is recommended.

Figure 36: IRIG-B Distribution Adapter

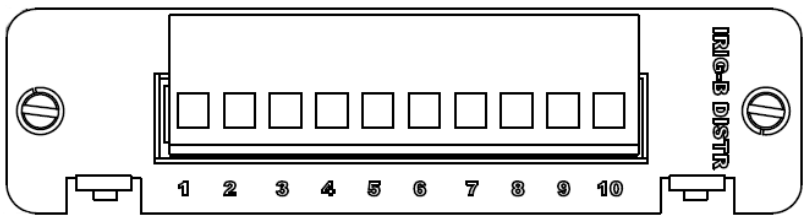


Table 13: IRIG-B Distribution Terminal Block Signal Definitions

Channel	Terminal Block Position	Function	Signal Flow
Channel 1	1	IRIG-B TTL	OUT
	2	GND	-
	3	FGND	-
Channel 2	4	IRIG-B TTL	OUT
	5	GND	-
Channel 3	6	IRIG-B TTL	OUT
	7	GND	-
	8	FGND	-
Channel 4	9	IRIG-B TTL	OUT
	10	GND	-

NOTE

The terminal block positions are numbered from 1 to 10 starting from the bottom of the card.

Hot standby fiber optic connections

The Hot Standby Fiber Optic Ethernet Switches support single-IP redundancy for the D400. They provide automated fail over between two Ethernet fiber optic network connections (**RX1/TX1** and **RX2/TX2**) that share a single MAC address. The 10-BaseFL switch (GE Item No. 520-0214) operates at 820-850 nm and the 100BaseFX switch (GE Item No. 520-0215) operates at 1300 nm.

Hot Standby Fiber Optic Ethernet Switches can be installed in the NET1 or NET2 slot (slots 11 and 12) on the D400.

If two Hot Standby Ethernet switches are installed in the NET slots, the system may be used in a dual-IP redundancy mode. That is, each switch can be configured with a different IP address to provide a back up network connection if the primary channel fails.

You can use the following glass optical fiber (GOF) cabling with the D400 Hot Standby Fiber Optic Ethernet Switches:

- 50/125 µm core/cladding multi-mode (gradient index) cable
- 62.5/125 µm core cladding multi-mode (gradient index) cable
- 100/140 µm core/cladding multi-mode (gradient index) cable
- 200 µm core Hard-Clad Silica (HCS) multi-mode (step index) cable

You can use the following fiber optic terminations for D400 cabling:

- ST Connectors

When calculating cable length, consider the following optical power levels:

- 100BaseFX optical transmitter power is –15.0 ± 4 dBm
- 100BaseFX optical fiber receiver sensitivity is typically –34.0 dBm
- 10BaseFL optical transmitter power is –19.0 ± 2 dBm
- 10BaseFL optical fiber receiver sensitivity is typically –31.0 dBm

⚠CAUTION

LED transmitters are classified as IEC 60825-1 Accessible Emission Limit (AEL) Class 1M. Class 1M devices are considered eye safe to the unaided eye. Do not view directly with optical instruments.

Table 14: Fiber Optic Connector Signal Definitions

Connector	Function
TX1	Primary Fiber Optic Transmit Port
RX1	Primary Fiber Optic Receive Port
TX2	Hot Standby Secondary Fiber Optic Transmit Port
RX2	Hot Standby Secondary Fiber Optic Receive Port

See "10Base-FL hot standby fiber optic ethernet switch" on page 44 or "100Base-FX hot standby fiber optic ethernet adapter" on page 45 for more information.

Network connections

The D400 supports a network interface through Ethernet connections to the 4-Port Twisted-Pair Ethernet Switch or Redundant Twisted-Pair Ethernet + COM2 Port Adapter. Within the operating system of the D400, the card in slot 11 is assigned to Ethernet interface *eth0* and the card in slot 12 is assigned to Ethernet interface *eth1*.

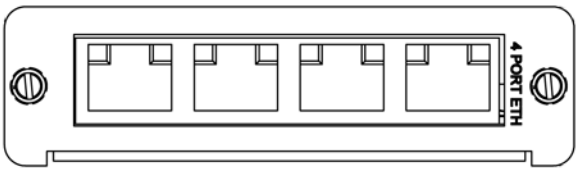
All RJ-45 connectors have the same signal definition. However, the rear Ethernet ports are auto MDI/MDIX and can support a straight-through or crossover cable.

See "4-Port twisted-pair ethernet switch" on page 43 and "Redundant twisted-pair ethernet + COM2 port adapter" on page 47 for more information.

To connect the D400 to network devices

Plug network cables into the D400 Ethernet ports.

Figure 37: D400 Ethernet ports



NOTE

If the D400 is deployed in the presence of strong RF energy in the 110 MHz to 125 MHz band, such as airport Instrument Landing System (ILS) localizers or aviation radio transmitters, it is recommended that shielded twisted-pair Ethernet cables be used.

Front network port

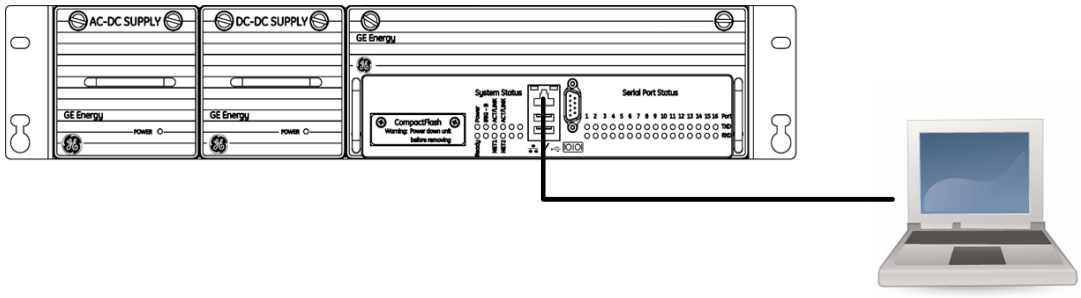
To access the D400's HMI, a local or portable PC can be directly connected to the network port located on the front panel of the D400.

The front network port is tied to the network interface card in the NET1 slot (slot 11) (*eth0* for configuration purposes in a single Ethernet configuration or *eth1* for dual Ethernet configuration).

To connect a local PC to the D400

Connect the supplied straight-through Ethernet cable (GE Item No. 977-0209) to your computer's network communications port and to the D400's front Ethernet port. Older computers without auto MDIX Ethernet capability may require an Ethernet cross-over cable.

Figure 38: Front network port



TIP

If your portable PC contains an older Ethernet chip and you are having difficulty connecting, try forcing the connection speed to 10 Mbps, full duplex, on your PC.

NOTE

The network interface must be configured before the network ports can be used. See "Connecting to the D400 for the first time" on page 81 for more information.

Table 15: Ethernet RJ-45 Connector Signal Definitions

Position	Function	Signal Flow	Color
1	RX+	IN	White w/ Orange
2	RX–	IN	Orange
3	TX+	OUT	White w/ Green
4	P1+	-	Blue
5	P1–	-	White w/ Blue
6	TX–	OUT	Green
7	P2+	-	White w/ Brown
8	P2–	-	Brown
	Shield	-	-

Table 16: Ethernet Crossover Cable (RJ-45) Pin Out

D400		Switch/Hub	
Name	**Pin**	**Pin**	**Name**
TX_D1+	1	3	RX_D2+
TX_D1–	2	6	RX_D2–
RX_D2+	3	1	TX_D1+
RX_D2–	4	2	TX_D1–
BI_D3+	5	7	BI_D4+
BI_D3–	6	8	BI_D4–
BI_D4+	7	4	BI_D3+
BI_D4–	8	5	BI_D3–

Table 17: Ethernet Straight-Through Cable (RJ-45) Pin Out

D400		PC	
Name	**Pin**	**Pin**	**Name**
TX_D1+	1	1	RX_D2+
TX_D1–	2	2	RX_D2–
RX_D2+	3	3	TX_D1+
RX_D2–	4	4	TX_D1–

D400		PC	
Name	Pin	Pin	Name
BI_D3+	5	5	BI_D4+
BI_D3–	6	6	BI_D4–
BI_D4+	7	7	BI_D3+
BI_D4–	8	8	BI_D3–

Modem connections

A COM2 port is provided on the COM2 Port Adapter or the Redundant TP Ethernet + COM2 Port Adapter. The COM2 port can support serial connections for the following dial-up interfaces:

- External modem
- Point-to-point protocol (PPP) services
- Wide area network

The COM2 port provides a single DB-9 connector wired for an RS-574 DTE signal. The COM2 Port Adapter plugs into any NET slot (slots 11 and 12) of the D400. The Redundant TP Ethernet + COM2 Port Adapter plugs into the NET1 slot (slot 11).

NOTE

The COM2 Port requires an external modem to provide dial-up functionality.

See “COM2 port adapter” on page 46 for more information.

To connect a modem to the COM2 Port Adapter

Connect a straight-through modem cable (not supplied with the D400) to the modem and the D400’s COM2 port. Connect using the settings provided below.

Modem Settings:

- Baud rate: 38400 bps
- Data bits: 8
- Parity: Disabled
- Stop bit: 1

Figure 39: Modem to COM2 port 2 adapter

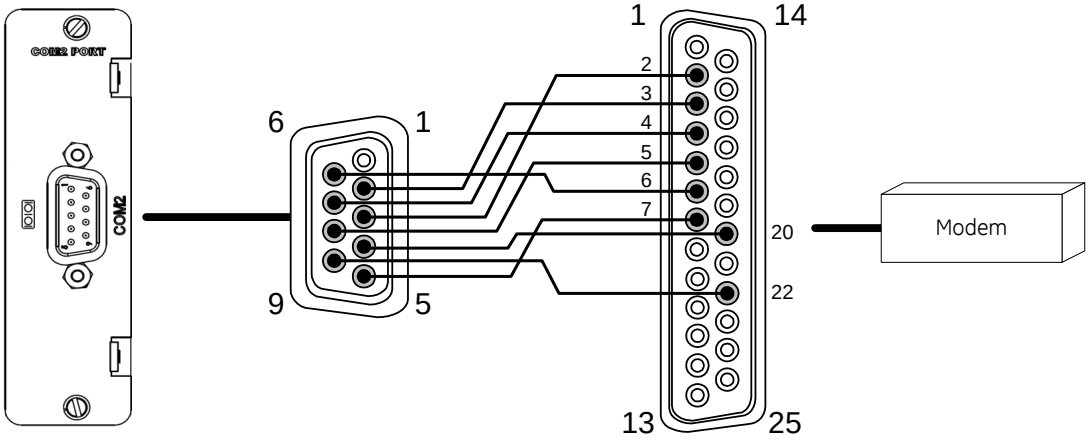


Table 18: COM2 Port DB-9 Connector Signal Definitions

Pin Number	DTE	
	Signal Acronym	Signal Flow
1	DCD	IN from DCE
2	RXD	IN from DCE
3	TXD	OUT to DCE
4	DTR	OUT to DCE
5	Signal GND	-
6	DSR	IN from DCE
7	RTS	OUT to DCE
8	CTS	IN from DCE
9	Not connected	-

Table 19: COM2 Port DB-9 to DB-25 Pin Out

Signal Acronym	DB-9 Pin #	DB-25 Pin #
TD	2	3
RD	3	2
RTS	4	20
CTS	5	7
DSR	6	6
DCD	7	4
DTR	8	5
GND	9	22

Local HMI connection

A permanent local workstation can be set up with the D400 to access the D400's Local HMI (human machine interface). The computer peripherals connect to the USB KVM Adapter located on the rear panel of the D400. The D400 supports the following peripheral connections:

- Three USB v1.1 compliant Type A ports for USB keyboard, mouse, touchscreen, or other USB device
- Single 3.5 mm audio jack for stereo audio output to speakers
- High-density D-sub 15-socket connector for video display

To connect a local substation computer to the USB KVM Adapter

NOTE

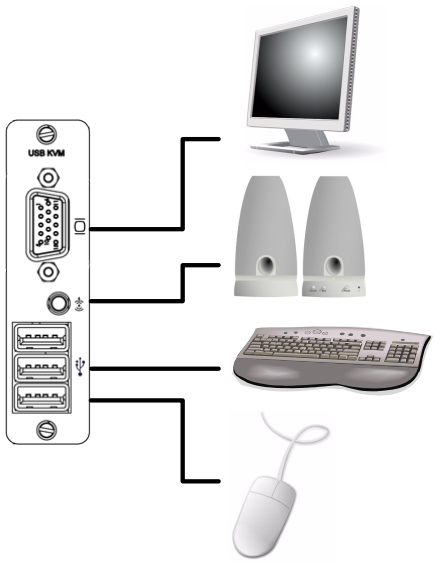
Ensure the D400 is powered down before connecting devices to the USB KVM card.

1. Connect the SVGA monitor to the video port.
2. Connect the keyboard and mouse to the USB ports.
3. Connect speakers (if available) to the audio jack.

TIP

You can also connect a USB touchscreen, keyboard, and mouse to the front USB ports.

Figure 40: USB KVM adaptor



The local HMI connection through the USB KVM card supports two simultaneous terminal sessions

- **tty1** is for the HMI session
- **tty2** is for the D400 command line interface

The local HMI connection defaults to the HMI session (tty1) when you log in.

To switch the terminal session at the D400 command prompt

- To the command line interface (tty2) at the D400 command prompt, press **Ctrl**-**Alt**-**F2**.
- Back to the HMI session, press **Ctrl**-**Alt**-**F1**.

For information on using the D400 command line interface, see the *D400 Software Configuration Guide*.

Front maintenance port

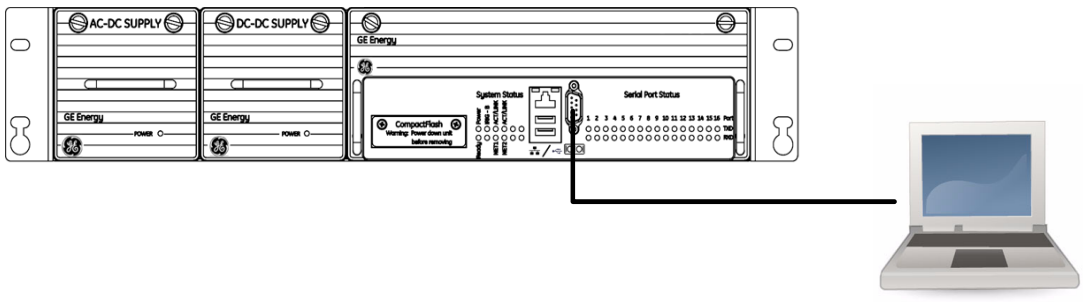
The serial communications port on the front panel of the D400 provides a local connection with the D400 to perform the initial setup of the D400 and to carry out maintenance and diagnostic procedures. The front maintenance port provides for a direct serial connection to a PC using a serial null modem cable (GE Item No. 977-0529), which is supplied with the D400.

See “Connecting to the D400 for the first time” on page 81 for more information on setting up communications with the D400.

To connect your computer to the D400

Connect the supplied serial null modem cable (GE Item No. 977-0529) to your computer’s serial communications port and to the D400's front serial communications port.

Figure 41: Front serial port



Minimal required connection

The minimal cable connection required to establish successful communication between your PC and the D400 is as follows:

PC Pin #	D400 Pin #	Signal Acronym
9-Pin Female	9-Pin Female (w/o Converter)	
2	3	TXD
3	2	RXD
5	5	GND

D400 system redundancy

A redundant D400 setup allows a secondary D400 to automatically take over operations from a paired D400 unit that has failed.

D400 equipment redundancy requires two D400 units and one or two RS232 switch panels. The RS232 switch panel is mandatory for Warm Standby redundancy.

NOTE

If the Hot Standby redundancy feature is available, the RS232 switch panel is optional.

A pair of LEDs marked *CCU A* and *CCU B* indicate which of the D400 units is currently active. If the hardware or software of the active unit fails, it is automatically switched offline and serial connections to the field are transferred to the standby unit. A toggle switch on the RS232 switch panel can be used to switch the D400 devices between active and standby modes.

Failover sequence

If the active D400 unit fails, the following actions occur:

1. The standby D400 unit detects the failure through the lack of a heartbeat signal on the ping cable or through a status change on the watchdog cable.
2. The standby D400 unit attempts to pull the RS232 switch panel to assume the active state.
3. The RS232 switch panel transfers all serial field connections to the standby D400, which then becomes the active D400.

Required components

To implement a redundant D400 system, you need the following components:

Component	Function	Part Number
RS232 Switch Panel	Communications switch.	517-0247
Power Supply	Power supply to power the RS232 switch panel. Input: 85 – 264 VAC or 90 – 350 VDC.	580-0046
Watchdog Cable Assembly	Connects D400 A to the RS232 switch panel.	977-0540
	Connects D400 B to the RS232 switch panel.	977-0541
Ping Cable Assembly	Links both D400 units to facilitate a heartbeat message that determines the status of the active unit.	977-0146
RS232 Serial Cable	Connects the D400 to the RS232 switch panel which is then connected to external field devices.	977-0145
Power/SysFail Cable	Connects the RS232 switch panel to an external power supply and to the D400 SysFail terminal block.	970-0161
Ground Cable	Provides a ground connection for the RS232 switch panel.	970-0182

NOTE

The serial ports on your D400 are galvanically isolated from each other, however, when the RS232 switch panel is used, the serial common of all ports are tied together.

NOTE

Pins 4 on switch panel connectors J2 through J9 are tied together and to the panel's power supply. Any loading from field devices on these pins will load the RS232 panel power supply and should be taken into consideration when sizing power supplies.

NOTE

The D400 RS232 adapter card that contains the redundancy control port must use the DTE (default) switch positions. Refer to *"Switch SW1/SW2 configuration" on page 32* and *"Switch SW3/SW4 configuration" on page 33*. This card must also be revision 08A or higher (the revision number is shown on a white label affixed to the top or bottom of the RS232 adapter card). If your card is 07C or below, please contact Customer Service.

To set up a redundant system:

It is recommended that you install and configure one standalone D400 unit to ensure that your configuration is valid and that device communications are operating properly. Once this is done, proceed with the installation of the redundant system.

1. Mount the D400 units in a rack and connect power and ground. Refer to "Power connections" on page 74.
2. Mount the RS232 switch panel.
3. Plug the connector of watchdog cable A (GE part no. 977-0540) to a serial connector on the first D400 (CCU A).
4. Plug the connector of watchdog cable B (GE part no. 977-0541) to a serial connector on the second D400 (CCU B). This cable must be connected to the same serial port number on both units.
5. Connect the bare leads of both watchdog cables to TB1 on the RS232 switch panel and the DB9 serial connector to either P1 or P9 as shown below.
6. Connect one end of the ping cable to the first D400 and the other end to the second D400. This ping cable must be connected to the same serial port number on both units.
7. Use standard RS232 cables (GE part no. 977-0145) to connect the D400 serial communication ports to the serial ports on the RS232 switch panel. P2 through P8 are connected to the first D400, P10 through P16 are connected to the second D400.

Connections from the switch panel to both D400 units should be made in the same order. For example, if P2 is connected to port 3 on the first D400, P10 should also be connected to port 3 on the second D400.

8. Connect field devices to J2 through J8 on the RS232 switch panel.
9. Configure the software according to the *D400 System Redundancy* section of the *D400 Substation Gateway Software Configuration Guide* (SWM0066).

To set up a redundant system with two RS232 switch panels:

In cases where more than 7 serial connection ports are required, a second RS232 panel can be added to the redundancy setup.

1. Mount the D400 units in a rack and connect power and ground. Refer to "Power connections" on page 74.
2. Mount the two RS232 switch panels.
3. Plug the connector of watchdog cable A (GE part no. 977-0540) to a serial connector on the first D400 (CCU A).
4. Plug the connector of watchdog cable B (GE part no. 977-0541) to a serial connector on the second D400 (CCU B). This cable must be connected to the same serial port number on both units.
5. Connect the bare leads of both watchdog cables to TB1 on the master RS232 switch panel as shown below.
6. Connect TB4 pins 1 (SET) and 2 (RESET) on the master RS232 switch panel to TB2 pins 1 and 2 on the slave RS232 switch panel using the cable specified (GE part no. 970-0161) or similar.
7. Remove jumpers Z1 and Z2 from the slave RS232 switch panel.
8. Connect one end of the ping cable to the first D400 and the other end to the second D400. This ping cable must be connected to the same serial port number on both units.
9. Use standard RS232 cables (GE part no. 977-0145) to connect the D400 serial communication ports to the serial ports on the RS232 switch panels. P2 through P8 are connected to the first D400, P10 through P16 are connected to the second D400. Connections from the switch panel to both D400 units should be made in the same order. For example, if P2 is connected to port 3 on the first D400, P10 should also be connected to port 3 on the second D400.
10. Connect field devices to J2 through J8 on the first RS232 switch panel and to J1 through J8 on the second panel.
11. Configure the software according to the *D400 System Redundancy* section of the *D400 Substation Gateway Software Configuration Guide* (SWM0066).

RS232 switch panel

The RS232 switch panel has two sets of indicator LEDS:

- PWR A/PWR B: When lit, power and communications are received from the connected units. Normally, both LEDs are lit.
- CCU A/CCU B: Normally, one LED is lit, indicating which unit is active.

The active/standby switch on the front of the RS232 switch panel is used to:

- Restore a previously failed unit to active status once it has been repaired.
- Manually force a unit to active status so that routine maintenance can be performed on the other unit.

To manually operate the RS232 switch panel:

1. Pull the active/standby switch straight out to release it from the locked position
2. Switch it up to make unit A active or down to make unit B active

The CCU A/CCU B LED indicator indicates which unit has been activated.

Redundancy wiring diagrams

The following diagrams illustrate how to wire the D400 units and RS232 switch panels to enable system redundancy:

- Redundancy Wiring - Single RS232 Switch Panel
  See "Redundancy Wiring - Single RS232 Switch Panel" on page 68.
- Redundancy Wiring - Dual RS232 Switch Panel. The wiring drawing is provided in two parts: left and right.
  - For the left side of the drawing, see "Redundancy Wiring - Dual RS232 Switch Panel (1 of 2)" on page 69
  - For the right side of the drawing, see "Redundancy Wiring - Dual RS232 Switch Panel (2 of 2)" on page 70

  This configuration is used to provide up to 15 serial connections to the redundant D400 units.
- Redundancy Wiring - Redundant RS232 Switch Panel. The wiring drawing is provided in two parts: left and right.
  - For the left side of the drawing, see "Redundancy Wiring - Redundant RS232 Switch Panel (1 of 2)" on page 71
  - For the left side of the drawing, see "Redundancy Wiring - Redundant RS232 Switch Panel (2 of 2)" on page 72

  This configuration is used to provide RS232 panel redundancy for up to 7 serial connections.

NOTE

When connecting to more than 7 field devices, you must double the number of RS232 switch panels used. When using this configuration, follow the instructions in "To set up a redundant system with two RS232 switch panels:" on page 66.

NOTE

The D400 watchdog (control) port, heartbeat (ping) port, and serial port assignments are software configurable. Refer to the *D400 System Redundancy* section in the *D400 Substation Gateway Software Configuration Guide* (SWM0066).

Figure 42: Redundancy Wiring - Single RS232 Switch Panel

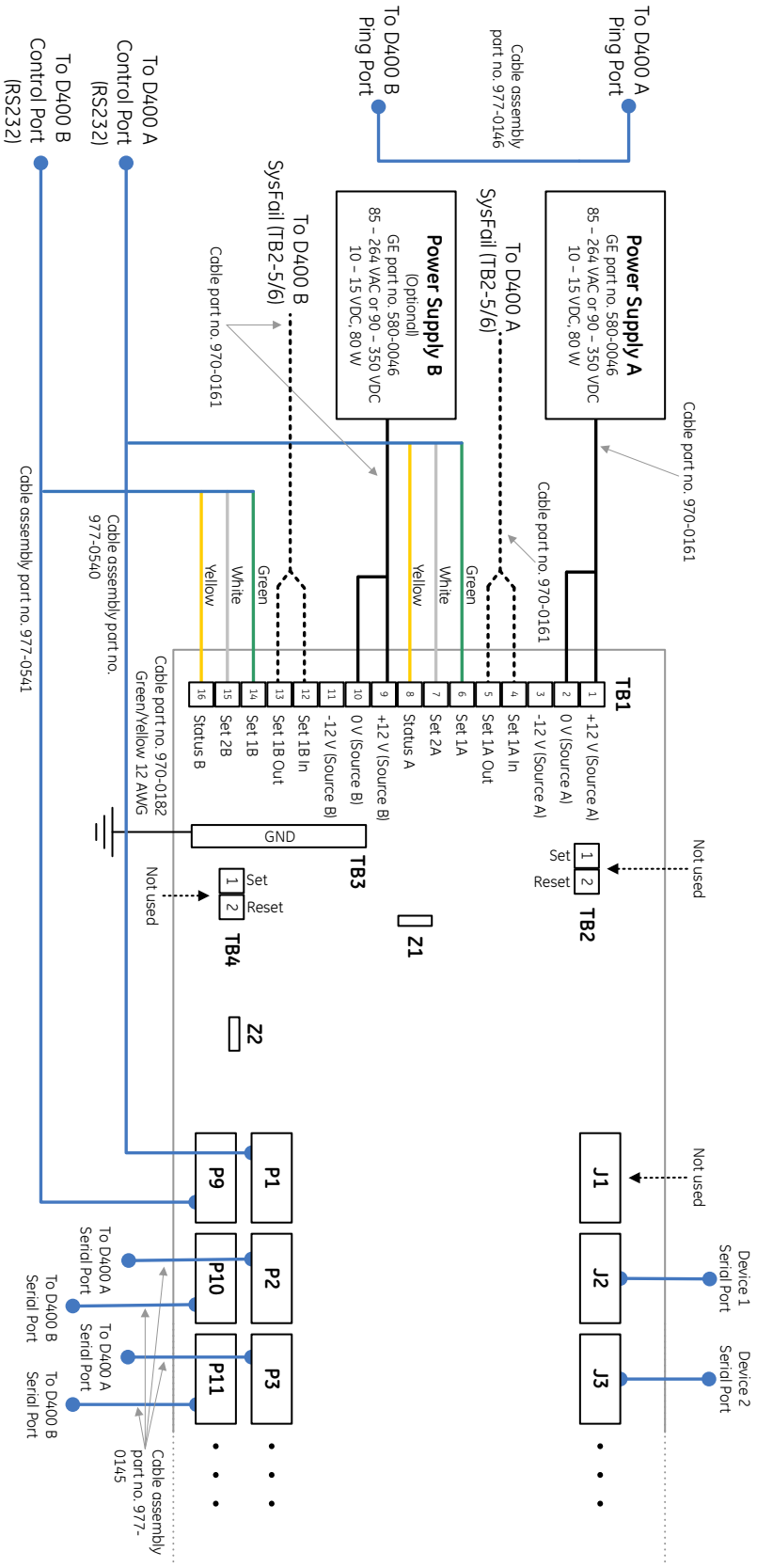


Figure 43: Redundancy Wiring - Dual RS232 Switch Panel (1 of 2)

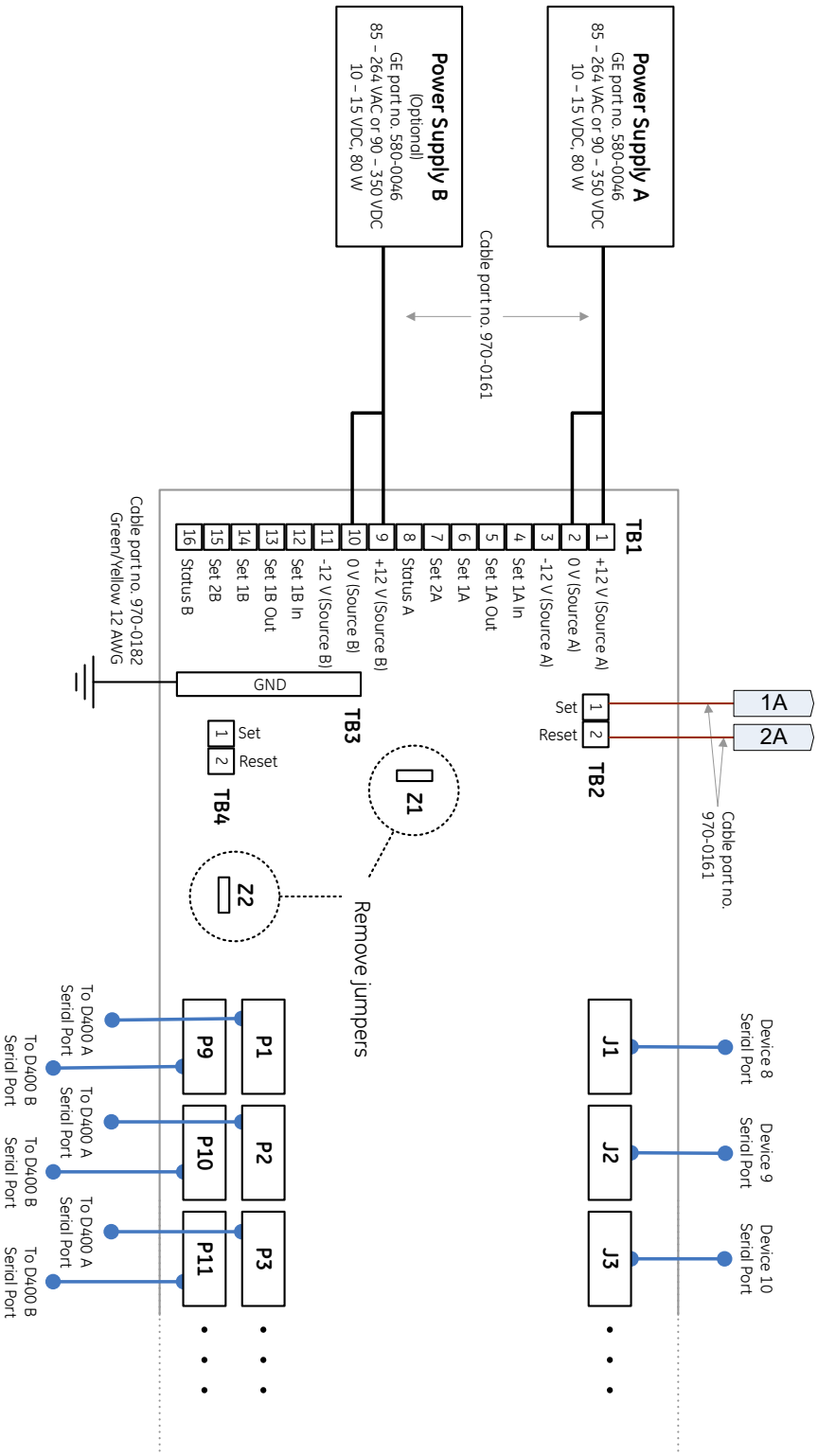


Figure 44: Redundancy Wiring - Dual RS232 Switch Panel (2 of 2)

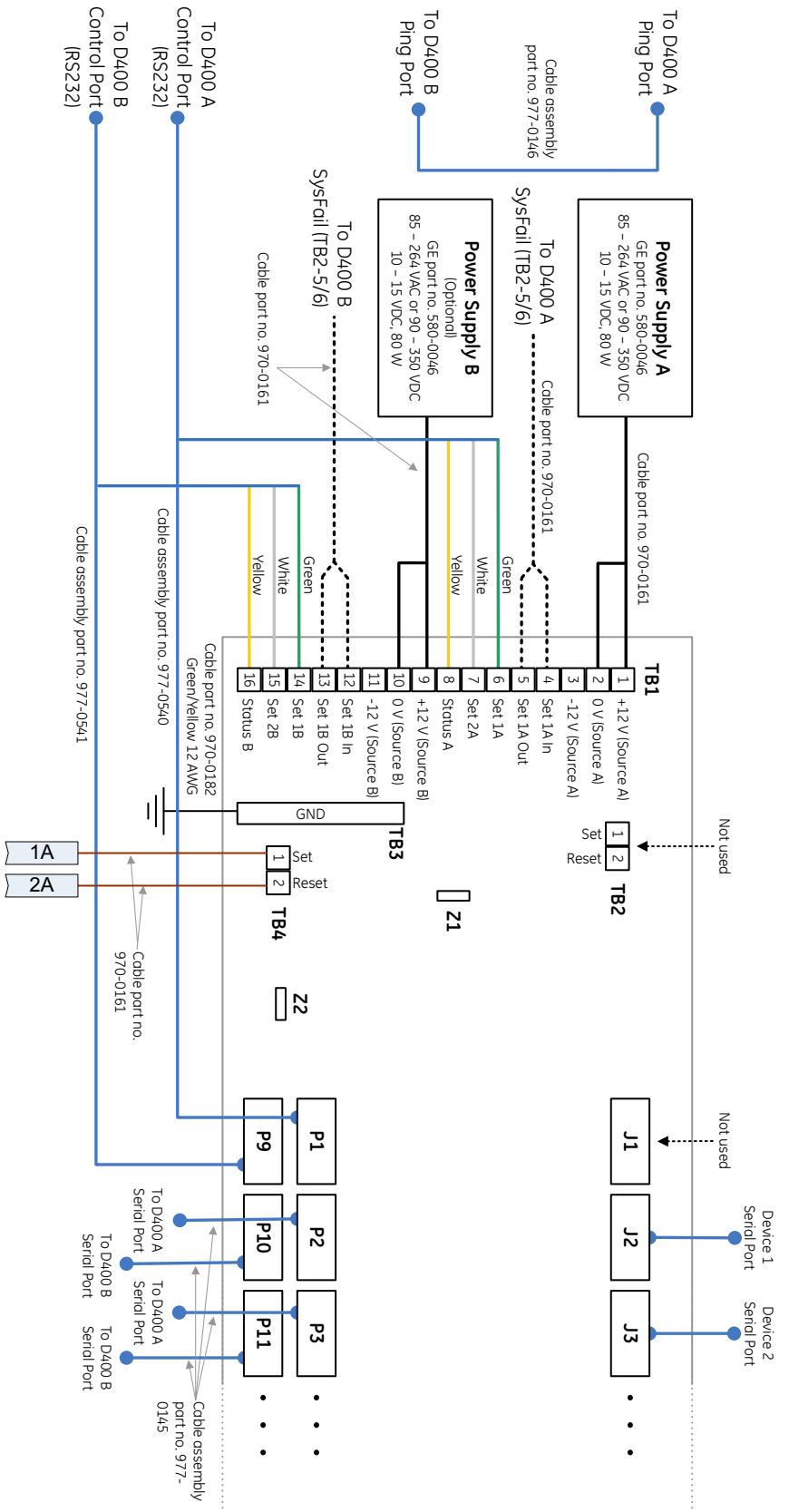


Figure 45: Redundancy Wiring - Redundant RS232 Switch Panel (1 of 2)

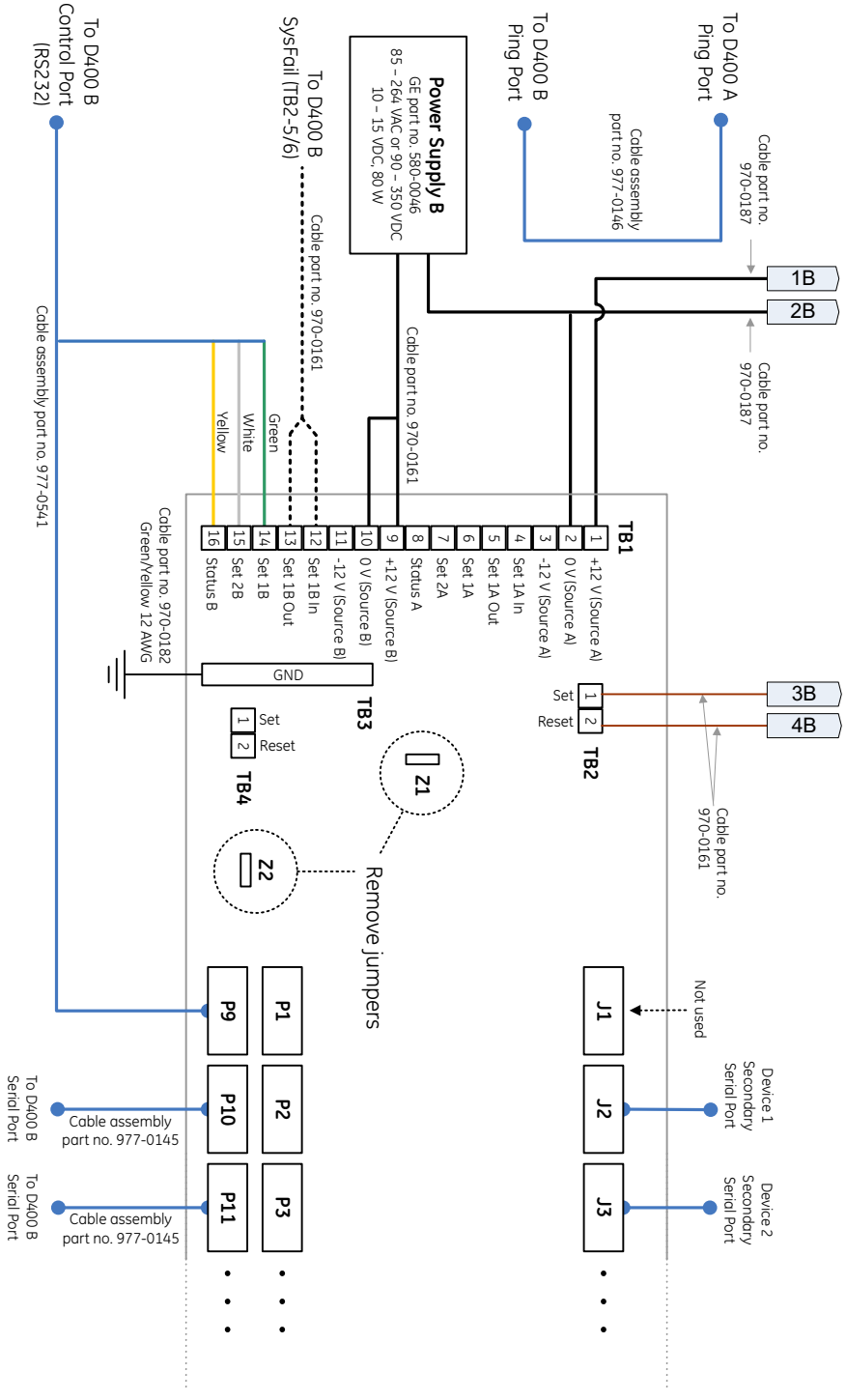
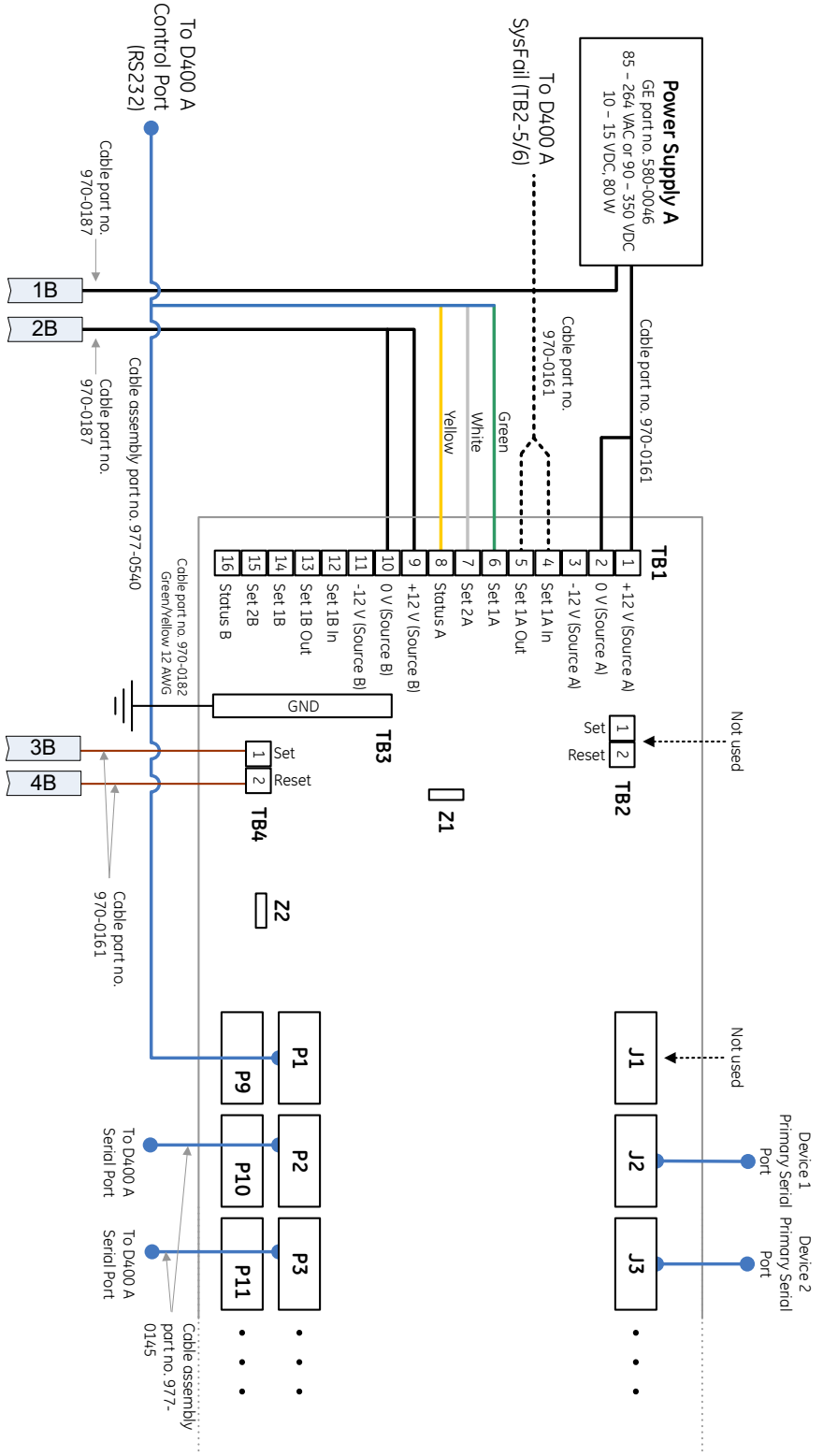


Figure 46: Redundancy Wiring - Redundant RS232 Switch Panel (2 of 2)



GE Energy

D400 Substation Gateway

Chapter 5: Powering Up the D400

This chapter describes the power supplies and how to make power connections.

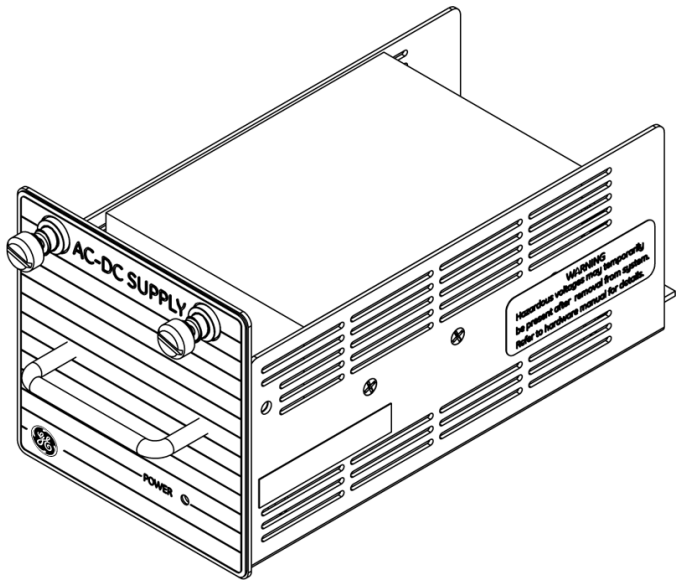
Power supply options

The D400 supports one or two power supplies that provide 5 V to the D400 main module. The following power supplies may be provided in the Power Supply slots:

- AC-DC power supply (GE Item No. 520-0217)
- DC-DC power converter (GE Item No. 520-0216)

For information on installing power supplies, see “Replacing the power supply” on page 105.

Figure 47: Power supply module



Redundant power supply

The D400 may be provided with an optional redundant power supply unit in Power Supply Slot 2. The second power supply provides continuous power to the D400 in the event the primary power supply unit fails.

Additional protection can be provided if a secondary external power source is available. In the event the primary power source fails, an automatic switchover will take place to the redundant power source to ensure continuous power to the D400.

Power configurations

The D400 supports the following power configurations:

- Single External AC Power Source
- Single External DC Power Source
- Two External AC Power Sources with optional redundant D400 AC-DC Power Supplies
- Two External DC Power Sources with optional redundant D400 DC-DC Power Converters

Power input ranges

Table 20: AC-DC Power Supply

Rated voltage range	100 to 240 VAC / 100 to 300 VDC with overvoltage protection of 110% to 150%	
Rated power	**If the unit is...**	**Then the rated power is...**
	AC	127 VA maximum
	DC	135 W maximum
Inrush current at 25°C on cold start	26.5 A_{peak} (< 145 VAC/205 VDC)	
	40 A_{peak} (< 264 VAC/370 VDC)	
Rated frequency	47 to 63 Hz (50/60 Hz)	

Table 21: DC-DC Power Supply

Rated voltage range	20 to 55 VDC with overvoltage protection of 110% to 150%
Rated power	135 W maximum
Inrush current at 25 °C	35 A_{peak} (< 60 VDC)

NOTICE

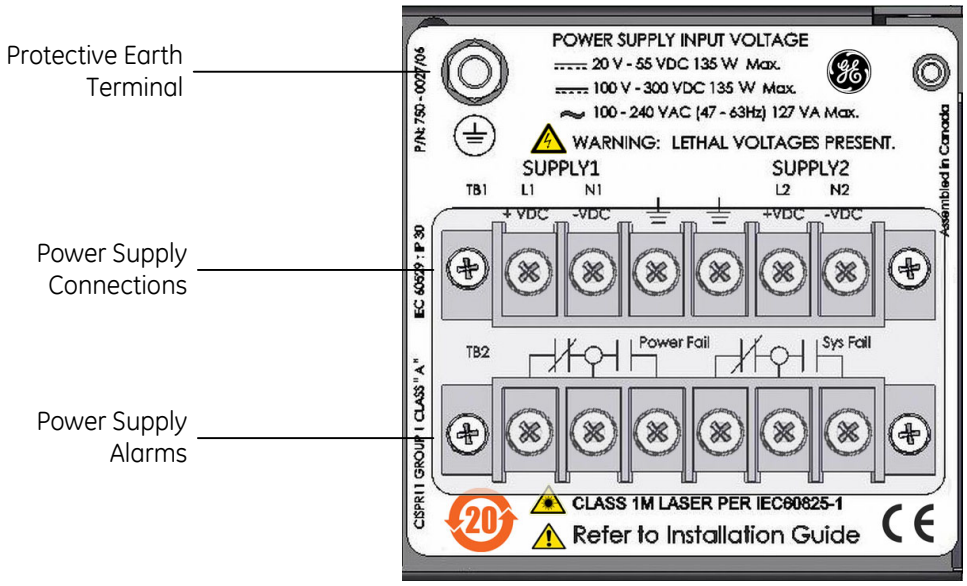
Applying AC voltages to a DC-DC power supply may cause irreparable damage.

Power connections

The D400 accepts power connections through two terminal blocks on the rear panel:

- Terminal block **TB1** is reserved for connecting power from one or two external sources to the D400.
- Terminal block **TB2** provides contact closure outputs for power supply fail and system fail alarms.

Figure 48: Power supply rear panel



NOTICE

The label on the power supply unit lists all possible power sources. Use only the source that conforms to the specifications of the installed power supply type.

Wiring requirements

The supply wiring for the D400 must be a minimum of 18 AWG [0.82 mm²], 3-conductor cable with an external insulation jacket, and a minimum certified voltage rating of 600 V. Consult local and national electrical wiring codes.

The protective conductor must be minimum 16 AWG [1.3 mm²] wire with (green-&-yellow) insulation. Recommended conductor size is 12 AWG [3.3 mm²].

The wires must be terminated with an insulated #6 Forked Terminal.

The clear plastic protective barrier provided with the terminal strip connector must be in place once wiring of the mains is completed.

External power requirements

Before connecting an external power source to the D400, ensure that the following external power requirements are met:

- An IEC 61010 qualified primary disconnect device and over current protection not exceeding 15 A must be externally provided in the AC/DC mains supply system.
- All current carrying conductors must be switched, including neutral (for AC) and negative (for DC).
- Primary disconnect device must be rated for the proper voltages (AC and/or DC), as well as inrush currents for the power supplies. “Power supply options” on page 73
- Protective earth conductor must be connected to the provided protective earth terminal before any mains power conductors.
- The primary disconnect device shall be in close proximity to the D400 equipment and easily accessed by the operator.
- The primary disconnect device shall be marked as the disconnecting device for the D400 equipment.

To connect the power source to the D400

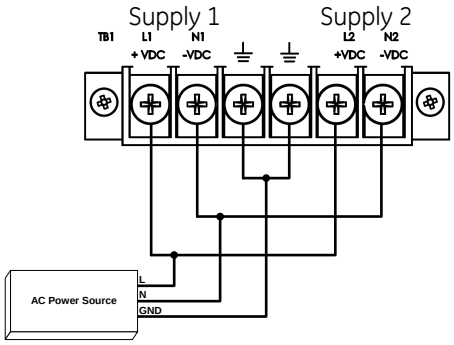
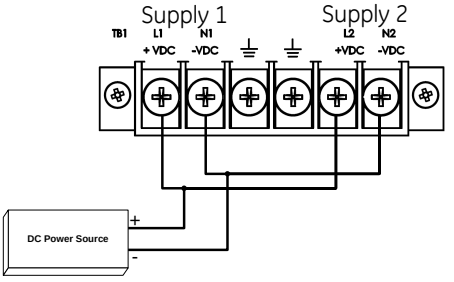
1. Remove the terminal block **TB1** protective plastic cover.
2. Connect power source as follows:

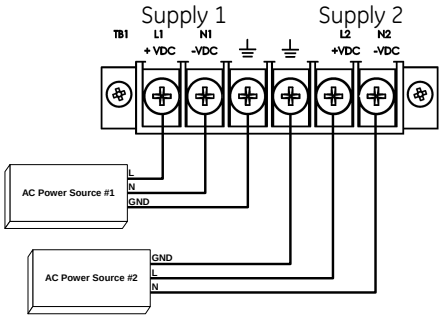
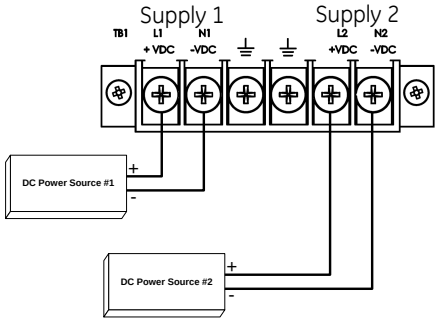
If your power supply is...	then...
AC	Connect the AC line connection to the **L** connection point(s) and the AC neutral connection to the **N** connection point(s) on terminal block **TB1**
DC	Connect the DC power supply, observing the correct polarity, to the **+VDC** and –**VDC** connection point(s) on terminal block **TB1**

For proper connection, the recommended tool torque settings for power terminal screws are 10.8 in-lb [1.22 Nm]. A Phillips (#1) screwdriver tip is recommended.

See the wiring diagrams in Table 22.

Table 22: Power Source Configurations

Power Source	Connection	Wiring Diagram
Single External AC Power Source	Connected to **SUPPLY1** and **SUPPLY2** input terminals.	
Single External DC Power Source	Connected to **SUPPLY1** and **SUPPLY2** input terminals.	

Power Source	Connection	Wiring Diagram
Two External AC Power Sources with Optional Redundant D400 AC/DC Power Supply	First source connected to **SUPPLY1** terminals. Second source connected to **SUPPLY2** terminals.	
Two External DC Power Sources with Optional Redundant D400 DC Power Converter	First source connected to **SUPPLY1** terminals. Second source connected to **SUPPLY2** terminals.	

3. Connect protective earth wire to the Protective Earth terminal ⏚ on the rear panel.

   The terminal is an M5 threaded stud with M5 nut and washers. The recommended order for stacking the washers on the chassis is: flat washer, ground wire ring terminal, toothed washer, M5 nut.

   For proper transient protection, the recommended tool torque settings for the M5 nut is 18.1 in-lb [2.04 Nm].

NOTE

   It is recommended to terminate 12 AWG green & yellow wire with a Panduit PV10-14R or equivalent ring terminal.

4. Verify that Power LEDs on the front panel of the power supplies and the D400 main module are lit.
5. Replace the terminal block protective plastic cover.

Power supply alarms

The D400 includes connections for two alarm outputs:

Power Fail to indicate one of the two power supplies or one of the two power feeds has failed

System Fail to indicate system operation status

Terminal block **TB2** on the rear panel of the D400 provides contact closure outputs for connection to an external circuit, for example, to connect an external LED indicator or audible alarm.

The contact closure used for alarm outputs is a solid-state photo-MOS device. Contact closure output ratings at maximum ambient temperature are:

- Continuous current: 0.1 A continuous at 300 VAC / 300 VDC
- Peak current: 0.28 A peak for 10 ms

- Maximum on resistance: 35 ohm
- Dielectric isolation: 2 kV_{RMS}

Power fail alarm

The Power Fail contact closure provides for an external indication upon loss of power. The Power Fail alarm is also indicated by the Power LED on the front panel of the power supply turning off.

The indicator or audible alarm can be wired to operate as follows:

- ON when a power failure has occurred
- ON when power is present

The Power Fail contact closure provides three contacts (terminals 1, 2 and 3) on terminal block **TB2**.

NOTICE

Contact closure rated for 0.1 A @ 300 V maximum.

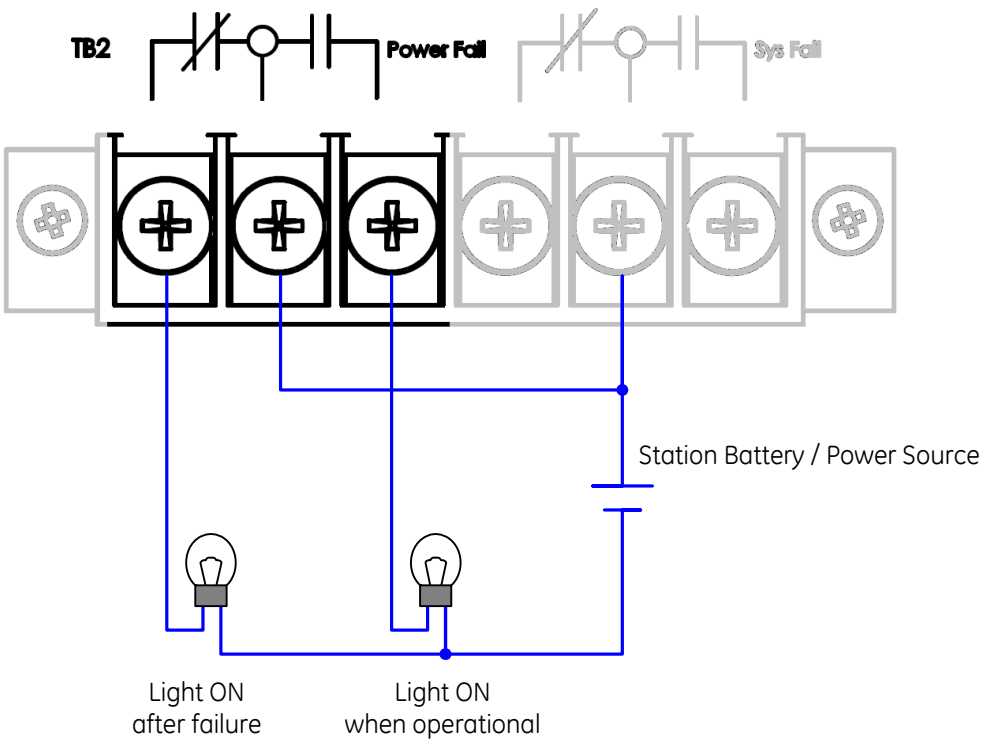
To connect the Power Fail contact closure

1. Remove the terminal block protective plastic cover.
2. Wire a lamp or audible alarm to terminals 1, 2 or 3 on terminal block **TB2** as follows (see figure):

To enable the indicator when power is...	Wire the lamp between...
Absent	Terminals 1 and 2
Present	Terminals 2 and 3

   For proper connection, the recommended tool torque settings for power terminal screws are 10.8 in-lb [1.22 Nm]. A Phillips (#1) screwdriver tip is recommended.
3. Replace the terminal block protective plastic cover.

Figure 49: Power Fail Alarm Connection



System fail alarm

The D400 includes a System Fail contact closure to provide an external indication of system status. The System Fail alarm is also indicated by the CPU Ready LED on the front panel of the main module turning off.

The indicator or audible alarm can be wired to operate as follows:

- ON when system failure has occurred
- ON when system is functioning properly

The System Fail contact closure provides three contacts (terminals 4, 5 and 6) on terminal block **TB2**.

NOTICE

Contact closure rated for 0.1 A @ 300 V maximum.

To connect the System Fail relay

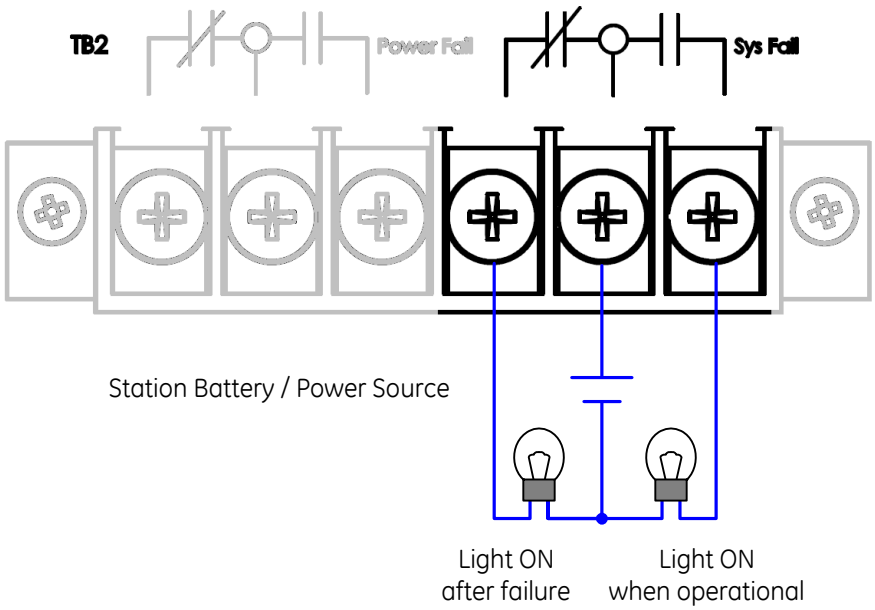
1. Remove the terminal block protective plastic cover.
2. Wire a lamp to terminals 4, 5 and 6 on terminal block **TB2** as follows:

To enable the indicator when system is...	Wire the lamp between...
Failed	Terminals 4 and 5
Functioning properly	Terminals 5 and 6

For proper connection, the recommended tool torque settings for power terminal screws are 10.8 in-lb [1.22 Nm].

3. Replace the terminal block protective plastic cover.

Figure 50: System Fail Alarm Connection



Powering down the D400

NOTICE

Powering down or shutting down the D400 without using the proper procedure could result in loss of system log data (SOE log, alarm log, user log, etc.), and could prevent the D400 from restarting properly. Follow the instructions provided to shut down the D400 safely.

The D400 is like a computer and the system must be shut down properly before removing the power. For the shut down procedure, see "Shutting down the D400" on page 96.

NOTE

It may take a couple of minutes for the D400 to fully shut down and for the CPU Ready LED to go off.

Once you have completely shut down the D400, you can safely disconnect the power.

GE Energy

D400 Substation Gateway

Chapter 6: Setting Up the D400

When you receive your D400, it is configured with default communication settings. To enable the D400 to communicate over your substation LAN you must change the settings as required by your network.

Refer to the D400 online Help and *D400 Software Configuration Guide* for complete information on configuring the D400.

Connecting to the D400 for the first time

To perform the initial set up of the D400, you need to plug directly into the D400 through the front serial communications port. The front communications port provides a local connection and terminal session with the D400 and is used to perform system administrative and maintenance procedures.

A terminal emulator program is required to set up a terminal session with the D400. This procedure is described using HyperTerminal® supplied with Microsoft Windows, but any terminal emulation program can be used.

To connect to the D400

1. Connect the supplied null modem cable (GE Item No. 977-0529) to your computer's serial communications port and to the D400's front communications port. See "Front maintenance port" on page 63 for cabling information.
2. From the Windows **Start** menu, select **Programs** > **Accessories** > **Communications** > **HyperTerminal**.

   Result: The **HyperTerminal** window opens and a connection wizard starts.
3. In the **Connection Description** dialog box, enter a **Name** for the connection. Click **OK**.

   The name you choose is *not* important.

NOTE

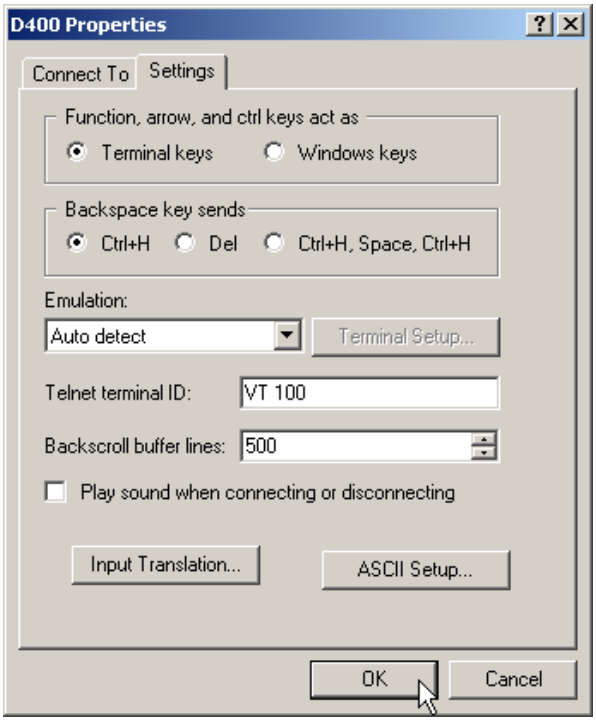
4. In the **Connect to** dialog box, select your computer's communication port (typically COM1) in the **Connect using** list. Click **OK.**
5. In the **Port Settings** dialog box, select the following options, and then click **OK**:

Bits per second	19200
Data bits	8
Parity	None
Stop bits	1

Flow control	None

6. On the **File** menu, click **Properties**. On the **Settings** tab, select the following options, and then click **OK**:

Function, arrow ...	Terminal keys
Emulation	Auto detect
Telnet terminal ID	VT 100
Backscroll buffer lines	500

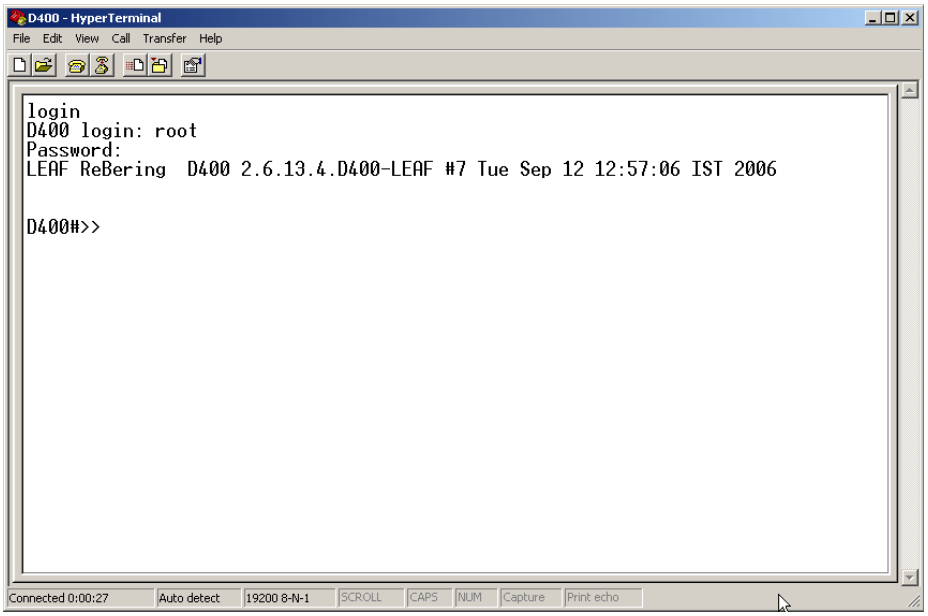


7. In the main terminal window, press **Enter**.
   Result: The D400 login prompt appears.
8. At the *D400 login* prompt, type the default username **root** and press **Enter**,
9. Type the default password **geroot** and press **Enter**.

NOTE

When you type in the password, it does not appear on the screen.

Result: The *D400#>>* command prompt appears. You are now online with the D400.



Setting up the network interface

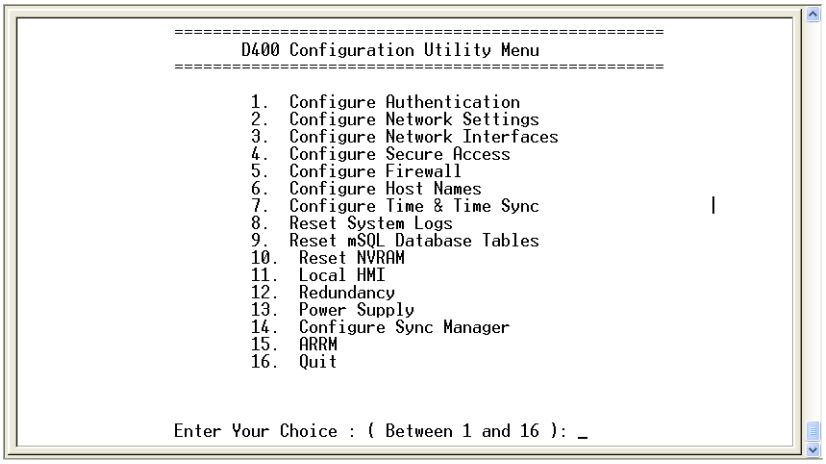
To set up the D400's network interface, you will need the following information:

- D400's assigned IP address
- Subnet Mask
- Gateway address (if applicable)

This set up must be done the first time from the D400's front serial communications port.

To configure the network interface

1. Connect to the front maintenance port. See "Connecting to the D400 for the first time" on page 81.
2. At the *D400*#>> prompt, type **d400cfg** and press **Enter**.
   Result: The **D400 Configuration Utility** menu appears.



3. Type **3** and press **Enter** to select **3. Configure Network Interface**.

   Result: The **Available Network Interfaces** menu appears.

NOTE

In a multiple network interface configuration you are prompted to enter which device to configure (NET1 or NET2).

4. Type **1** and press **Enter** to select **1. Net1**, or type **2** and press **Enter** to select **2. Net2**.

   Result: The Network Interface : Net1 or Net2 menu appears.

5. Type **2** and press **Enter** to select **2. Static IP Address**.

   Result: You are prompted to enter the D400's IP address.

6. Type the IP address of the D400 and press **Enter**, or press **Enter** to accept a previously-set IP address.

   The default IP address is *192.168.168.81*.

7. Enter the Subnet Mask of the D400, or press **Enter** to accept a previously-set subnet mask.

   The default Subnet Mask is *255.255.255.0*.

   Result: You are prompted to configure the gateway settings.

8. Do one of the following:
   - If a default gateway is not required, enter **n**.
   - If a default gateway is needed, enter **y** and then enter the Gateway IP address.

   Result: A summary of the configured network configuration displays

```
                    2.  Static IP Address
                    3.  Dynamic Address
                    4.  Back


          Enter Your Choice : ( Between 1 and 4 ): 2
          Enter IP Address[192.168.168.81]: 192.168.168.81
          Enter Subnet Mask[255.255.255.0]: 255.255.255.0


          Set a default Gateway [Y/N]?:   n


          Newly configured static IP settings


          IP Address is:          192.168.168.81
          Netmask is:             255.255.255.0
          Broadcast Address is:   192.168.168.255


          Do you wish to accept this [Y/N]?:
```

9. Do one of the following:
   - To accept the settings, enter **y**.
   - To change the settings, enter **n** and repeat Steps 4 to 8 to make the necessary changes.

10. Go back to the D400 Configuration Utility Menu, and select **16. Quit** to exit the configuration utility.

11. At the *D400#>>* prompt, type **reboot** and press **Enter**.

    The D400 restarts and is updated with the new network settings.

    You can now configure the D400 using the D400 HMI over the network connection. See Chapter 7, *Using the D400*. You must create administrator-level user accounts before you can access the D400 remotely through TELNET or SSH.

NOTE

You may also have to modify your local network connection on your PC if you want to plug directly into the D400's front network port. The PC connecting to the front Ethernet port of the D400 must be configured to be on the same network as Net1 (slot 11) and the host ID must be unique to the network.

Creating administrator-level user accounts

Since you cannot use the root user account to access the D400 remotely, you must create administrator-level user accounts for this purpose. This must be done for the first time through the D400's front serial communications port.

To create a new administrator-level user account:

1. Connect to the front maintenance port. See "Connecting to the D400 for the first time" on page 81.
2. At the *D400#>>* prompt, type **d400cfg** and press **Enter**.
3. Type **1** and press **Enter** to select **1. Configure Authentication**.
4. Type **6** and press **Enter** to select **6. Administrator Group Users**.
5. Complete the on screen prompts as required to create a new administrator-level user.

   You may now use this user account to access the D400 remotely through TELNET or SSH.

NOTE

By default, the D400 is configured to restrict access to various command line services like TELNET and SSH to administrator-level users only. You can use the **Configure Administrator Only Logins** setting under **Secure Access** to change this parameter and allow both administrator- and supervisor-level access.

Setting up secure web access

The D400 provides security features to authenticate its identity and to maintain the privacy of information between the D400 and your computer when communicating over the Internet. The D400 makes use of digital signatures and secure Web access to ensure this security.

Secure Web access to the D400 is provided using the Secure Sockets Layer (SSL) protocol over a 128-bit connection. To support the D400's secure Web access features, you need to obtain and install a security certificate and a private key on the D400.

Prerequisites

You will need the following items to set up secure Web access for the D400:

- Approved IP address, host name and fully qualified domain name for the D400
- Security certificate and private key

Requesting a certificate

Security certificates are issued by independent certification authorities (CAs). Your Web browser must host the certificate for the CA you choose to use. Refer to your browser's configuration to find out which certification authorities are supported. Optionally, you can install a CA's certificate if it doesn't exist in your browser.

To obtain a certificate, you need to create and send a Certificate Signing Request (CSR) to the CA. At the same time you create the CSR, you will also be creating a private key. The CSR and the provided certificate and private key are supplied in individual text files, typically named *server.csr*, *server.crt* and *server.key* respectively.

To obtain a security certificate and private key

Contact a certification authority to request a certificate and to create your private key. When making your CSR request, provide the host name of the D400 (the full name that users will enter in the Web browser to connect to the D400) for the certificate's "Common Name", and specify a non-encrypted private key file.

When you receive your certificate and private key, you should create a back up copy and store it in a secure place other than the D400.

Installing the certificate and key

Once you have obtained your security certificate and private key, you can install them on the D400 in two ways:

- Secure Copy - requires a PC with an installed Secure Copy Program (SCP) and a network connection to the D400
- USB Portable Memory Device - requires local access to the D400

Before installing the certificate and key, check that the files are named as follows and rename if necessary:

- Certificate is **server.crt**
- Private key is **server.key**

To install using Secure Copy

1. Start the Secure Copy Program.
2. Connect to and log in to the D400 using your network connection.
3. Using the Secure Copy Program, copy the *server.crt* and *server.key* files to the following directory on the D400: */mnt/usr/D400_SysConfig/Certificate*
4. Reboot the D400. See “Shutting down the D400” on page 96.

To install from the USB drive

1. Copy the *server.crt* and *server.key* files to the root directory of the USB drive.
2. Insert the USB drive into one of the front USB ports on the D400.
3. Start a terminal session and log in to the D400.
4. At the D400 command prompt, enter the following commands:
   mkdir /mnt/usbdrive
   mount -t vfat /dev/sda1 /mnt/usbdrive
   cp /mnt/usbdrive/server.crt /mnt/usr/_SysConfig/Certificate
   cp /mnt/usbdrive/server.key /mnt/usr/_SysConfig/Certificate
   sync
   umount /dev/sda1
5. Remove the USB drive.
6. Reboot the D400. See “Shutting down the D400” on page 96.

Since a USB drive could be lost or stolen, it is recommended you remove the private key and certificate from the USB drive once you are done installing them on the D400.

Once you have installed and set up your security certificate, your secure Web access with the D400 is enabled. From this point on, whenever you access the D400 HMI using a Web browser, the D400 will automatically send you its Web site certificate, and your Web browser will display a lock icon on the status bar. This indicates that you have a secure connection with the D400.

NOTE

If you receive any other security warnings or do not see the secure connection icon in your Web browser, your computer and network connection may not be safe from outside intruders. Check with your IT administrator on how to proceed.

Testing the network connection

Once you have finished setting up the D400's network interface, you may want to test the connection to ensure that your computer and the D400 are communicating properly. To test the connection, you can run the ping command at the D400's command line interface. To use the ping command your computer must be set up in the same subnet mask as the D400.

NOTE

For security reasons, the D400 will not reply to ping messages by default. D400 ping reply behavior can be modified using the d400cfg utility.

To test the network connection using ping

1. Using the front maintenance port, start a Telnet session and log into the D400.
2. At the *D400#>>* prompt, type **ping** followed by your computer's IP address and press **Enter**.

   If you get a reply, then the communication is working between the D400 and your computer.

   If you do not get a reply, check the following items:

   - You entered the IP address correctly in the ping command.
   - Your computer is set up in the same subnet mask as the D400.
   - The network interface setup in the D400 is correct.

GE Energy

D400 Substation Gateway

Chapter 7: Using the D400

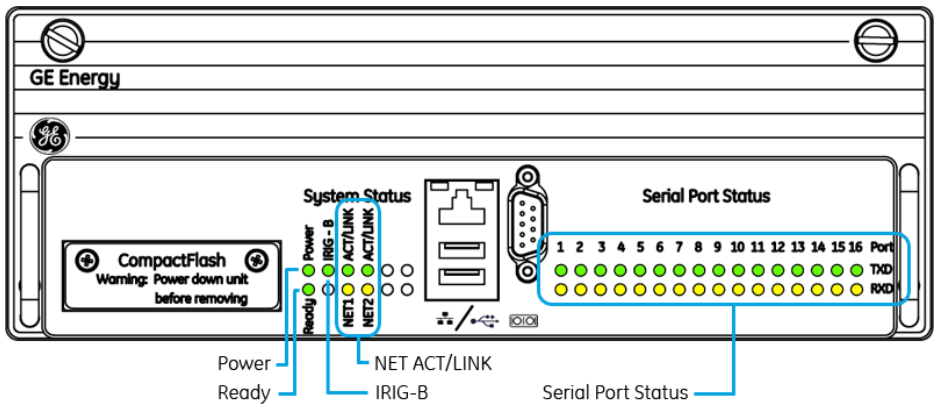
This chapter describes the user interfaces available with the D400. The:

- Front panel LEDs allow you to view the operational status of the D400.
- D400 HMI allows you to view and configure the operational status of the D400.
- System Utilities allow you to manage the D400 system setup.

Front panel LEDs

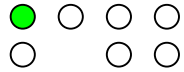
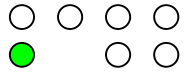
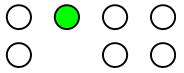
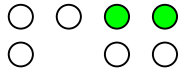
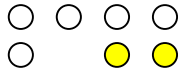
Once the D400 is powered up, the LED indicators on the front panel of the D400 become active. The indicators provide status information on the operation of the D400.

Figure 51: D400 Front LEDs



System status LEDs

The System Status LEDs indicate the unit's operational status:

LED Display	Status Description
	Power is correctly supplied to the unit (+5 V present on the D400 Main Board).
	Initialization (boot-up and self-diagnostics) of the D400 is complete and the unit is ready to process data.
	IRIG-B signal is being correctly processed. This LED flashes at a 2 Hz rate.
	Link integrity for the Ethernet Switch in NET1 and NET2 slots. See note below.
	Transmission activity for the Ethernet Switch in NET1 and NET2 slots. See note below.

NOTE

The NET2 ACT/LINK LEDs on the front panel may not be properly driven on the D400 Main Module with FPGA revision V1.4 and earlier when using the Redundant TP Ethernet + COM2 Port card (GE Item No. 520-0218). To check the FPGA revision, enter **dmesg -s 16392 | grep -i FPGA** at the D400 command prompt and search for FPGA in the output.

Serial port status LEDs

The Serial Port Status LEDs provide a visual indication of the status for each serial communication port. For a given serial communication port:

LED Display	Status Description
TXD	Serial transmission activity on the serial port
RXD	Serial reception activity on the serial port

NOTE

If a pair of LEDs is not lit, it does not indicate a problem, only that the connected device is not active at that moment.

NOTE

If a serial communication card slot is empty, (that is, no card is installed) the serial Receive (**RXD**) LED may be lit.

Substation HMI

The productName includes a built-in HMI (human machine interface). The HMI is your window into the productName. Through the HMI you can monitor the status of your substation network, view data, execute control commands, configure devices and SCADA masters, and change the system set-up.

The HMI includes the following components:

- Runtime HMI to view and control the operation of the power network. An optional One Line Viewer is available for viewing one-line diagrams. Power bar buttons give access to productName display screens and utilities.
- Configuration tool to manage configuration settings directly on the productName. Includes One Line Designer for creating/editing one-line diagrams. Accessed from the Configuration Power bar button.
- Command line interface to configure platform level components. Accessed from the Utilities Power bar button.

The productName, depending on how it is configured, is protected by a secure HTTPS or standard HTTP access that requires a user name and password. Your HMI user access level determines which productName HMI features you have access to and what your privileges are in the run-time and configuration tools.

For more information on the productName HMI, refer to the online Help once you have logged in.

The productName, when equipped with a 1.0 GHz CPU, also includes a Local HMI that offers all the features of the productName HMI through a local connection. A feature-reduced version of the Local HMI is available for productName units containing a 650 MHz CPU.

productName HMI

You can use a network connection and your computer's Web browser to access the productName HMI.

The productName HMI Login screen may not appear correctly if you are using Internet Explorer 8 with the Security level set to High. To see the entire Login screen, set the Security level to Medium: go to **Tools** > **Internet Options** > **Security** > **Local Intranet** > **Custom Level** > **Reset to**.

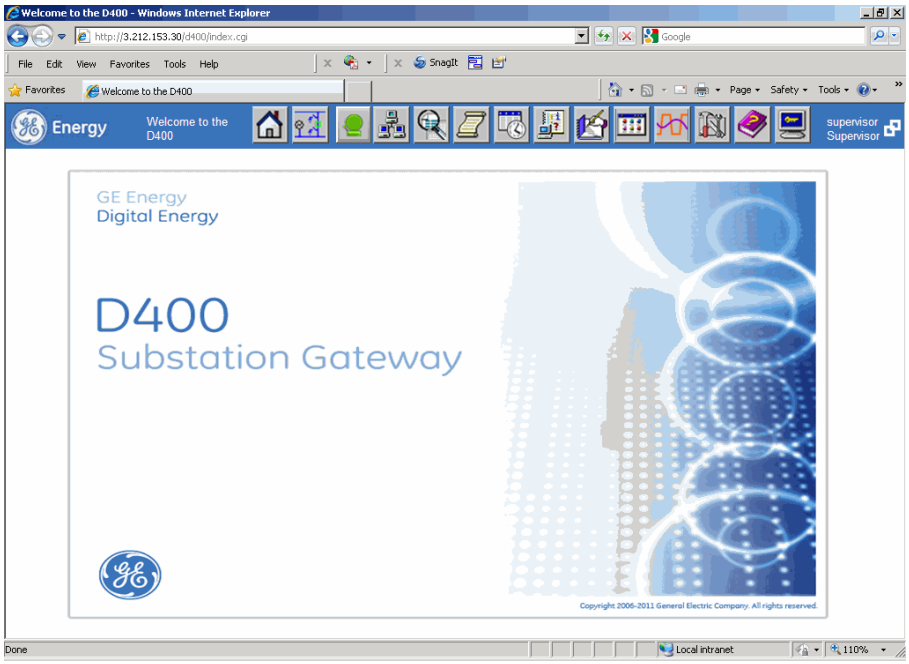
The productName supports a network connection over the LAN or through a connection to the productName's front network port. For network connection setup information, see "Network connections" on page 59".

The productName HMI is based on the web-based programming language Java. The Web browser must be equipped with a plug-in that supports Java. The productName is designed to operate with version 6.0 (or later) of the *Internet Explorer*®. If you are using *Internet Explorer*, version 6.0 or later you may need to install the J2SE® Runtime Environment (JRE). You must have the JRE Version 6.0 (or later) installed and enabled on your PC to operate the productName HMI. When you log into the productName, the productName automatically detects if your Web browser has the JRE installed. If not, the JVM Detection window gives choices for installing the JRE.

To access the productName HMI over a network connection

1. Open your Web browser and enter the URL (in the form of *http://aaa.bbb.ccc.ddd)* of the productName. The **Log In** screen displays. The default IP address is http://192.168.168.81.
2. Type your HMI Supervisor user name and password. The default user name is **supervisor** and the default password is **super123$**.
3. Click **Log In**.

   Result: If your login is successful, the productName Home page appears.



Local HMI

The access to the Local HMI is through a keyboard, monitor, and mouse connected to the USB KVM card on the rear panel of the productName. For KVM setup information, see “Local HMI connection” on page 62.

The productName’s Local HMI is presented within an X Windows environment running on the Linux operating system. It provides limited functionality from the standard HMI. You cannot configure the productName through the Local HMI.

To access the Local HMI from a local substation computer

1. If not already on, turn on the video display monitor.

   If you just powered up the productName, wait for the start up messages to complete and the productName login prompt to appear.
2. At the productName login prompt, enter your productName administrator user name (default is **root**) and your administrator password (default is **geroot**). Leave the IP address at 127.0.0.1.
3. Click **Connect**. X Windows starts and the Local HMI main screen displays.

X Windows functions

The Local HMI is an application with a title bar. Once the user has logged in the application window may be minimized, moved, or closed through the controls on the right hand side of the title bar. An application toolbar displays across the bottom of the screen. Click the **productName** button on the toolbar and select an option from the shortcut menu.

The following functions are available:

- Operator Interface – opens an additional HMI session
- X Terminal – displays the productName#>> command prompt in a pop-up window from which you can run the productName system utilities
- Quit – closes the HMI session and X Windows and returns you to the productName#>> prompt. To restart windows, enter *startx*.
- Restart – restarts the windows manager without ending the HMI session.

Log out

The local HMI does not have a session timeout. So you must log out of the HMI and the productName command line interface to fully exit and secure the system.

To log out from the local HMI

1. Click **X** on the title bar.
2. At the *productName#>>* prompt, type **logout** and press **Enter**.

   Result: The productName login prompt displays.

The monitor is set to go into standby mode when not used for a few minutes. Touch the keyboard or mouse to wake it up.

If the keyboard stops responding during use, simply unplug and re-connect the keyboard cable.

System utilities

The productName includes on-board utilities for managing the productName system setup, such as network settings, passwords, system time, and advanced configuration and diagnostic tools. The System Utilities are accessed at the command line interface using a terminal session.

You can access the command line interface in a few ways:

- Local terminal session through the front maintenance port
- Local substation computer connected to the KVM adapter
- Telnet/SSH terminal session through a network connection

For more information on using the System Utilities, see the *productName Software Configuration Guide*.

From the front maintenance port

To access the productName utilities through the front maintenance port

- See “Connecting to the D400 for the first time” on page 81.

From the local substation computer

To access the productName utilities through the local substation computer

- See “To access the Local HMI from a local substation computer” on page 92.

Over a network connection

Once you have completed the initial network interface setup, you can initiate a Telnet/SSH session through one of the productName network connections to access the System utilities. You need terminal emulation software that supports the Telnet and SSH protocols. Windows is supplied with HyperTerminal, which supports a Telnet session, but does not include an SSH terminal emulator. This must be obtained and installed separately.

You cannot use the root user account to access your productName remotely. You must use an Administrator-level user account (or a Supervisor-level user account, if so configured). Refer to “Creating administrator-level user accounts” on page 85 for more information.

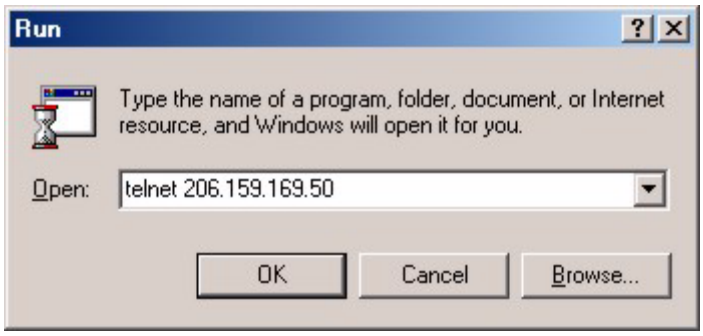
You can also initiate a Telnet/SSH session by clicking the **Utilities** button on the Power bar in the productName HMI.

TIP

When accessing the productName with an Administrator-level user account, you may not have sufficient security privileges to execute the all commands listed in the user documentation. If this occurs, type "**sudo** " in front of each command.

To access the productName utilities through a Telnet session in Windows

1. From the Windows Start menu, select **Run**.
2. In the Run dialog box, enter telnet *<your productName's IP Address>* and click **OK**.



The command prompt window displays.

3. Log in to the productName.

To access the productName utilities through a SSH session

1. Open the terminal emulator program.
2. Enter the productName's IP address and use SSH port number 22.
3. Log in to the productName.

File transfer

The productName contains two CompactFlash cards on the main board to store software and data:

- System CompactFlash card stores system firmware
- User CompactFlash card is accessible from the front panel and stores system data such as event logs

To copy files from the CompactFlash cards you can use an ftp session through the productName's command line interface or a portable memory device connected to the productName's front USB port.

To copy files using ftp:

1. Connect and log in to the productName using a terminal session.
2. At the productName command prompt, type **ftp**.
3. Enter one of the following commands to go to the file directories:
   - **cd /mnt/hmi**System directory where firmware is located
   - **cd /home/Configure**Configuration directory where configuration files are located

USB portable memory device

The productName accepts a USB portable memory device from the front USB port. The USB port does not currently auto detect the memory device so you need to manually mount it.

To connect a USB portable memory device:

1. Insert the USB drive in the top front USB port.
2. Connect and log in to the productName using terminal session.
3. At the productName command prompt, enter **mkdir /mnt/frontusb1**.
4. Enter **mount –t vfat /dev/sda1 /mnt/frontusb1 –o shortname=win95**.

System status points

You can obtain status information about your productName through several system points. These points can be viewed through the *Application* tab on the Point Summary window.

Table 23: productName System Status Points

Name	Data Type	Description
Power Supply 1 Good	Digital Input	Value is 1 when a failure has occurred or the power supply is not installed. Because this point remains online even when the power supply is not installed, you can force the point for the missing supply to the offline state or you can apply a tag indicating that the unit is not installed.
Power Supply 2 Good	Digital Input	
IRIG-B Enabled	Digital Input	Value is 1 when enabled
IRIG-B Watchdog Expired	Digital Input	Value is 1 when expired
Front Port Link Good	Digital Input	Value is 1 when true Note that "Active" is not the same as "Activity". It is used in the same sense as Active and Standby for redundant Ethernet configurations. The point does not flicker on and off in the same way that the activity LED does for an Ethernet port. The actual number of ports available depend on the configured options of the productName unit. Points associated with unavailable ports are made offline and invalid.
NET1 Port 1 Link Good	Digital Input	
NET1 Port 1 Active	Digital Input	
NET1 Port 2 Link Good	Digital Input	
NET1 Port 2 Active	Digital Input	
NET1 Port 3 Link Good	Digital Input	
NET1 Port 3 Active	Digital Input	
NET1 Port 4 Link Good	Digital Input	
NET1 Port 4 Active	Digital Input	
NET2 Port 1 Link Good	Digital Input	
NET2 Port 1 Active	Digital Input	
NET2 Port 2 Link Good	Digital Input	
NET2 Port 2 Active	Digital Input	
NET2 Port 3 Link Good	Digital Input	
NET2 Port 3 Active	Digital Input	
NET2 Port 4 Link Good	Digital Input	
NET2 Port 4 Active	Digital Input	
System PLD Revision	Analog Input	A string that describes the revision or ID number of the specified component.
Main Board ID	Analog Input	
Mid-Plane ID	Analog Input	
NET1 Card ID	Analog Input	
NET2 Card ID	Analog Input	
USB KVM Card ID	Analog Input	

NOTE

FPGA Version 1.10 or above is required to provide system status points for the power supplies and 100BASE-FX card. In previous FPGA versions, these points appear as offline regardless of their actual status. If your FPGA version is 1.09 or less, please contact Product Support.

Shutting down the D400

NOTICE

Powering down or shutting down the D400 without using the proper procedure could result in loss of system log data (SOE log, alarm log, user log, etc.), and could prevent the D400 from restarting properly. Follow the instructions provided to shut down the D400 safely.

Like a computer, you should shut down the D400 before removing power or to perform a complete system reboot. Shutting down the D400 ensures that all applications are properly terminated, settings are saved, and the CPU is safely turned off. It also helps for a smoother restart.

The shut down command is run at the D400's command line interface and can be performed locally or remotely using a terminal session. You have the option to completely halt operation of the D400 or to stop and then restart it.

To shut down the D400 before powering down

1. Log in to the D400 system. See "System utilities" on page 93.
2. At the D400 command prompt, type **shutdown -h now** and press **Enter**.

   The D400 shuts down. If you are performing the shut down locally, you can verify that the **CPU Ready** LED on the D400 front panel turns off and the **System Fail** power supply alarm is set (if wired). You can now safely disconnect the power.

NOTE

It may take a couple of minutes for the D400 to fully shut down and for the CPU Ready LED to go off.

To reboot the D400

1. Log in to the D400 system. See "System utilities" on page 93.
2. At the D400 command prompt, type **shutdown -r now** and press **Enter**.

   The D400 software shuts down and then restarts automatically. Once the restart is complete, you can log back into the D400.

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Chapter 8: Servicing the D400

The D400 does not require any scheduled maintenance. However, you may need to replace the following parts occasionally:

- System battery
- CompactFlash card

A periodic inspection is also suggested to ensure that:

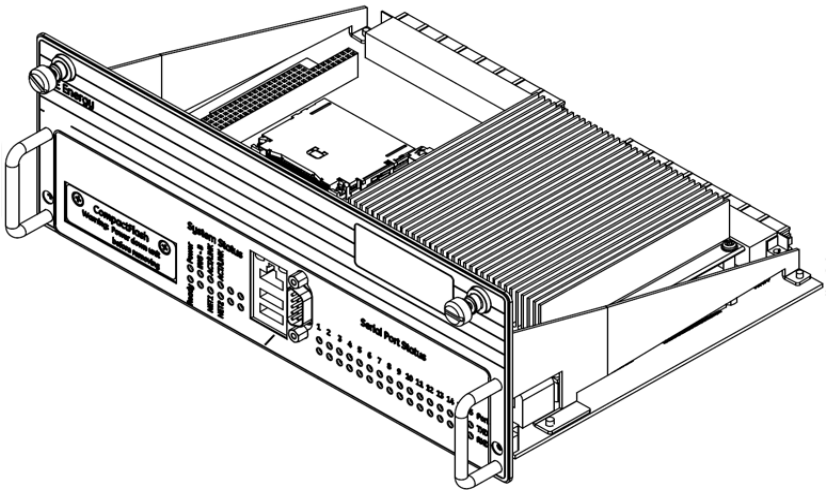
- Unit has sustained no accidental physical damage
- Airflow is not obstructed
- Connectors and cables are intact and firmly attached
- Battery condition is good

Only trained personnel should perform maintenance on the D400.

Removing the D400 main module

You need to remove the D400 main module from the chassis to access the system battery and the main CompactFlash card for maintenance.

Figure 52: D400 Main Module



To remove and re-insert the D400 main module

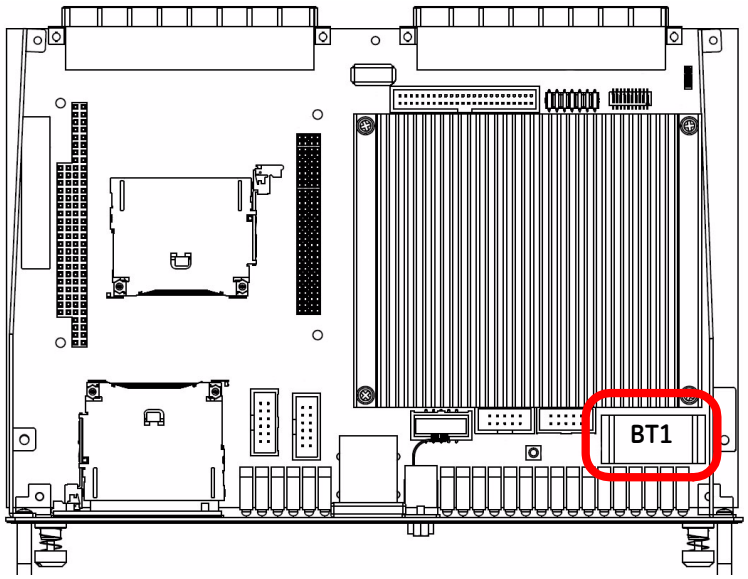
1. Power down the D400.
2. Hand-loosen the two screws on the front panel of the D400 main module.
3. Grasping the two handles, pull out the D400 main module.
4. Make the necessary changes.
5. Slide the main module back into the chassis. Push firmly to ensure the connectors at the rear of the main board are fully seated.
6. While pressing the main module panel right against the chassis frame, hand-tighten the two screws on the front panel.
7. Power up the D400 and verify that the **Power** LED is illuminated.

Replacing the battery

The lithium battery maintains power to the D400's NVRAM if there is a power disconnect. The D400 is supplied with a 1/2AA 3.6 V 0.9 Ah Lithium battery that you must insert on the D400 main board when the D400 is installed. To ensure the battery is good, it is recommended you check the battery voltage before installation and replace the battery every five years.

You can access the battery compartment by removing the D400 main module from the chassis. The battery holder **BT1** is located near the front corner of the board, behind the two rows of Serial Port Status LEDs.

Figure 53: D400 Battery Location



Before you remove the battery...

NOTICE

Note the following items before you begin battery replacement:

- Disconnect power to the D400 before changing the battery.
- Avoid exposure to high temperatures, such as soldering or spot-welding
- Avoid excessive force to terminals
- Use extreme caution and proper procedures for servicing electrostatically sensitive components. Electrostatically sensitive components are located near the battery.

NOTE

Removing the battery causes the internal clock to reset and the non-volatile RAM to be erased.

Supported battery types

The D400 is supplied with a 1/2AA 3.6 V 0.9 Ah Lithium Thionyl Chloride non-rechargeable battery (GE Item No. 980-0038). The following battery types may be used as a replacement.

Table 24: Supported Battery Types

Manufacturer	Mfg. Part No.
Tadiran®	TL-2150
Tadiran	TL-4902
Tadiran	TL-5101
Tadiran	TL-5902
Toshiba®	ER3V
Toshiba	ER4V
Saft®	LS-14250
Saft	LS-14250C
Sonnenschein®	SL-350
Sonnenschein	SL-750

Manufacturer	Mfg. Part No.
Maxell®	ER3
XENO Energy	XL-050F

To insert or replace the D400 battery

Ensure that all hazardous live circuits are isolated or disconnected before attempting battery replacement.

1. Power down the D400.
2. Remove the D400 main module from the chassis. See “Removing the D400 main module” on page 97.
3. Using a plastic or other non-conductive tool, pry the black plastic clip holding the battery cover away from the battery holder **BT1**. When free, the battery and clip can be removed together.
4. Remove the cover from the battery holder and keep it.
5. Place the new battery into the battery holder, ensuring polarity is correct.
6. Replace the cover and press down until the clips click into the retaining notches of the battery holder.
7. Replace the D400 main module.
8. Power up the D400 and verify that the Power LED is illuminated.

Checking voltage

To check battery voltage, use a meter or other measuring device that has a high input impedance (10 Mohm or higher).

Cleaning and handling Lithium batteries

- Wear gloves or finger caps when handling batteries to keep them clean.
- Use non-conductive cleaning solution to prevent deterioration of battery performance
- Dry batteries at a temperature below 85 °C to prevent seal deterioration that may, in turn, result in leakage

Recycling of batteries

The D400 Lithium battery is recyclable and does not contain mercury, cadmium, or lead in levels above those regulated by the European Union. Recycle the battery according to local waste management regulations.

In accordance with European Directive 2006/66/EC, batteries are marked with the crossed out wheeled bin, which indicates that they cannot be disposed of as unsorted municipal waste in the European Union. Users of batteries must use the collection points available to customers for the return, recycling, and treatment of batteries. Customer participation is important to minimize the negative effects of batteries to the environment and sustain available natural resources. For more information see www.weeerohsinfo.com.

Battery life

If the battery is disconnected, or if the D400 is never powered down, the life of the battery should exceed five years. The life of the battery will be severely shortened if the battery is left connected while the D400 is powered down for extended periods or stored.

For long-term storage:

- Remove the battery
- Keep the equipment at temperatures and humidity below normal
- Avoid shorting or loading while stored

Dual ethernet upgrade kit

The D400 Dual Ethernet Upgrade Kit (GE part number 501-0612) allows you to upgrade your existing D400 device to support dual Ethernet network connections. This upgrade kit contains the following components:

- PC/104-Plus 10/100BaseT Ethernet Module card (GE part number 580-2717)
- Ethernet card to main board cable assembly (GE part number 975-0122)
- Phillips screws (4 pieces)
- Hexagonal standoffs (4 pieces)
- Hexagonal nuts (4 pieces)

Valid combinations

This upgrade can be performed using the following components:

D400 Main Board	Ethernet Module Card	Network Cards
GE part no. 520-0204 [650 MHz] GE part no. 520-0205 [1.0 GHz]	GE part no. 580-2717 Compatible with all released versions of D400 firmware	GE part no. 520-0218 [NET1 slot] GE part no. 520-0213 [NET2 slot] GE part no. 520-0214 [NET2 slot] GE part no. 520-0215 [NET2 slot]

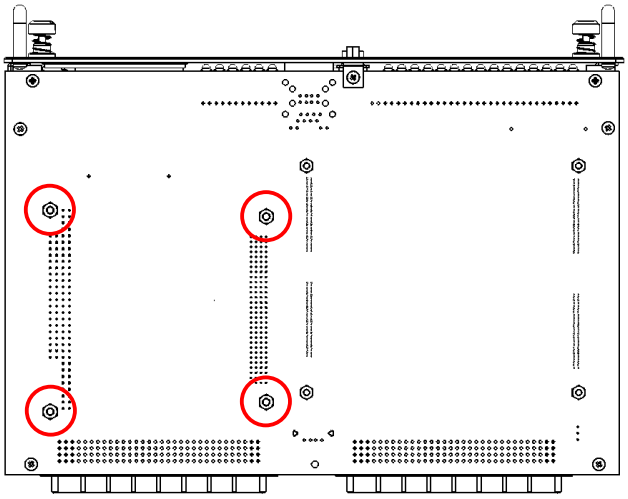
NOTICE

Perform this procedure on an ESD-safe surface to prevent damage to the D400 device and its components.

Installing the Dual Ethernet Upgrade Kit:

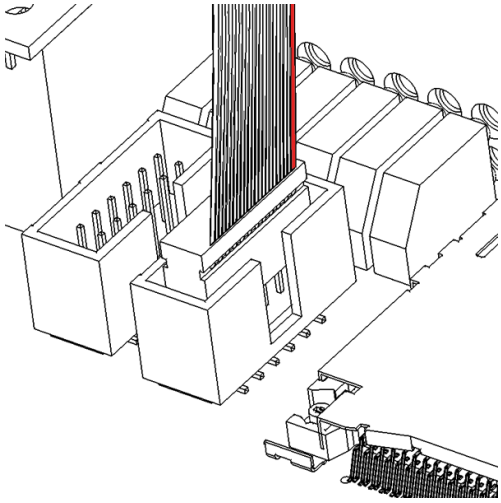
1. Power down your D400 device.
2. Remove the D400 main module from the chassis. See “Removing the D400 main module” on page 97.
3. Locate the four mounting holes in the D400 main module PCB board noted below. Attach the hexagonal standoffs to the top of the main board and secure the standoffs using the four provided hexagonal nuts.

Figure 54: Dual Ethernet upgrade kit - four mounting holes

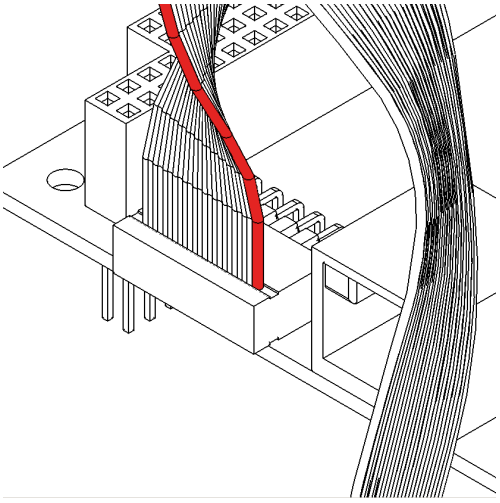


4. Plug the provided cable assembly into connector **P3** on the D400 main module. Plug the other end of this cable into connector **J5** on the Ethernet Module card.

Figure 55: Dual Ethernet upgrade kit - cable connection



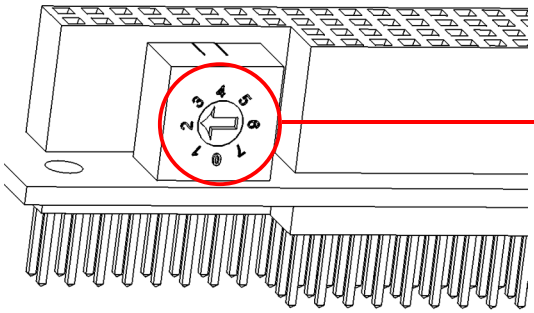
Connector P3 – red wire closest to face of unit



Connector J5 – red wire closest to Ethernet port

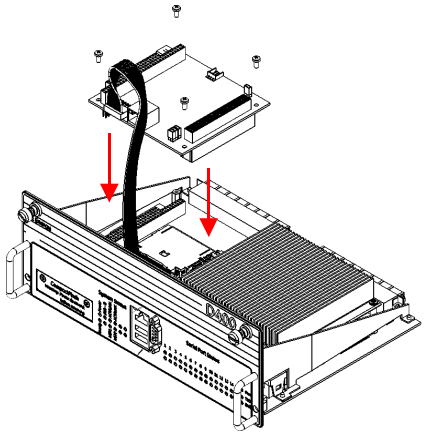
5. Ensure that rotary switch **U11** on the Ethernet Module card is set to position **2**.

Figure 56: Dual Ethernet upgrade kit - rotary switch position



6. Attach the Ethernet Module card to the expansion slot and secure using the four provided Philips screws.

Figure 57: Dual Ethernet upgrade kit - attach Ethernet module card



7. Replace the D400 main module.
8. Power up the D400 and configure the network connections as required using **d400cfg**. Refer to the *D400 Configuration Utility* section in the D400 Substation Gateway Software User's Manual for more information.

Changing the compact flash

CompactFlash cards are designed with flash technology, a non-volatile storage solution that can retain data indefinitely without a battery. The cards are solid state, meaning they contain no moving parts, and provide much greater protection of data than conventional magnetic disk drives.

The D400 contains two CompactFlash cards on the main board to store software and data:

- Main CompactFlash card located at connector **P2** stores system firmware
- User CompactFlash card located at connector **P1** is accessible from the front panel and stores system data such as event logs

NOTE

Use the following Industrial Temp CompactFlash cards:

- GE part number: 160-0125 (1 GB Industrial Temp CompactFlash Non-DMA) for the Main or User CompactFlash.
- GE part number: 160-0124 (16 GB Industrial Temp CompactFlash) for the User CompactFlash

To change the Main CompactFlash card

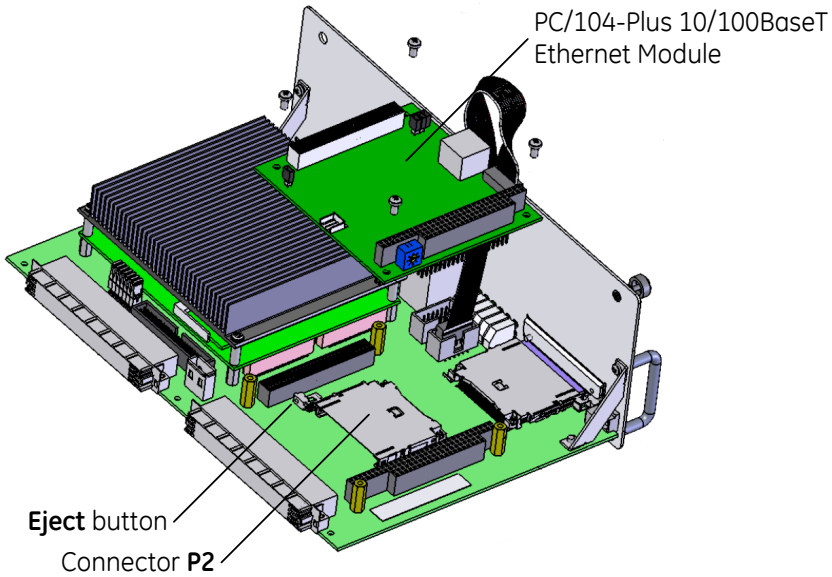
1. Power down the D400.
2. Remove the D400 main module from the chassis. See “Removing the D400 main module” on page 97.

   If your D400 contains the Redundant Twisted-Pair Ethernet + COM2 Port Adapter:

   2.1. Unscrew the four Philips screws attaching the PC/104-Plus 10/100BaseT Ethernet Module card to the expansion slot.

   2.2. Lift the card straight up to detach and move it aside. Do not disconnect the ribbon cable from the main module.
3. At connector **P2**, press the **Eject** button to eject the CompactFlash card.
4. Insert the new CompactFlash card.
   - Reattach the Ethernet Module to the expansion slot and replace the four screws.
5. Replace the D400 main module.
6. Power up the D400.

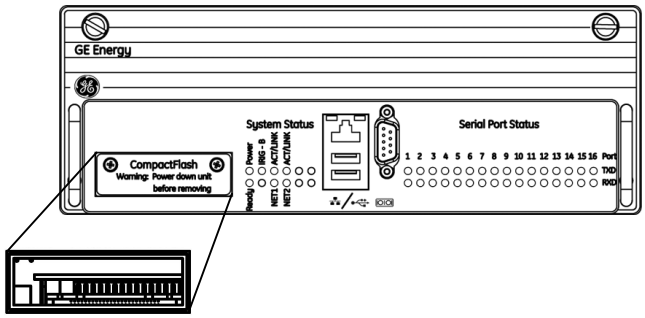
Figure 58: Replace the main CompactFlash card



To change the User CompactFlash card

1. Power down the D400.
2. Using a Phillips Screwdriver, remove the screws from the CompactFlash slot cover located on the front panel of the D400 main module.
3. Press the **Eject** button to eject the CompactFlash card.
4. Insert the new CompactFlash card into the slot.
5. Replace the CompactFlash slot cover and secure it with the screws.
6. Power up the D400.

Figure 59: Change the user CompactFlash card



Replacing the power supply

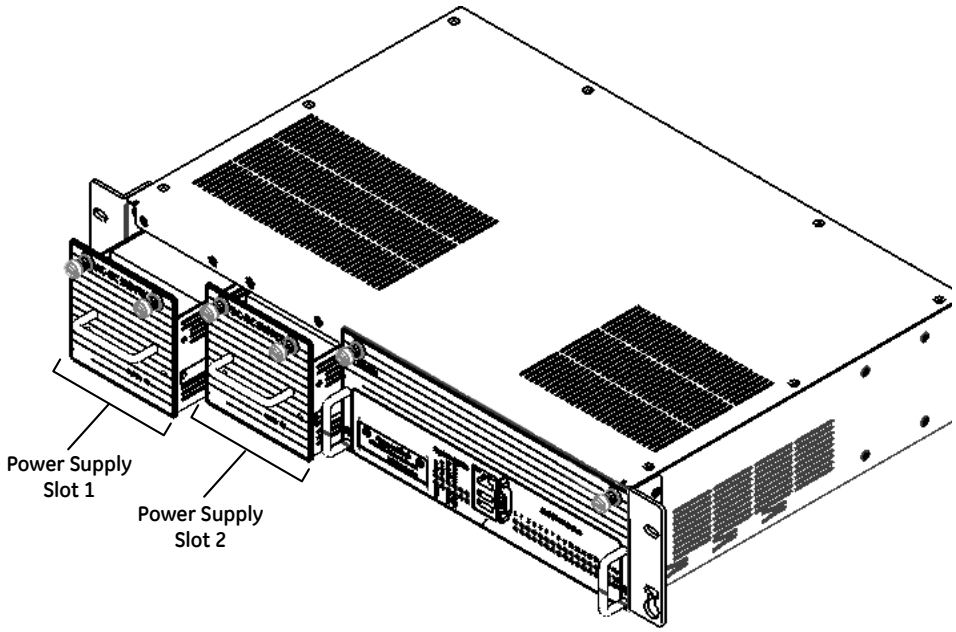
The D400 may contain one or two power supplies (AC-DC and/or DC/DC) in the power supply slots. The D400 may be supplied with an optional redundant power supply (in Slot 2) to provide dual hot swappable power supplies. The power supply module is accessible and easily replaced from the D400 front panel.

If the D400 contains dual power supplies, you can replace one power supply unit without having to power down the D400, as long as the other power supply unit is operational.

NOTE

The D400 power supplies do not contain user replaceable fuses. The entire power supply module must be replaced if the fuse has failed.

Figure 60: D400 Power Supply Unit



Before You Remove the Power Supply...

Note the following items before you begin power supply replacement.

- Ensure the other power supply unit (if available) is functioning (the green **Power** LED is illuminated) to ensure that the D400 doesn't power down during replacement.

- Make sure that the unit is wired in accordance with “Power connections” on page 74.

Dangerous voltages may be present after the power supply chassis has been removed from the D400. Wait 10 seconds for stored energy to dissipate.

To replace D400 power supply units

1. If only a single power supply unit is installed (in Slot 1), power down the D400. If dual power supplies are installed (in Slot 1 and Slot 2), ensure that the secondary unit is functioning.
2. Hand-loosen the two screws on the front panel of the power supply unit.
3. Pulling on the handle, slide the power supply unit out of the chassis.
4. Slide the new power supply unit into the chassis.
5. While pressing the power supply module panel right against the chassis frame, hand-tighten the two screws on the front panel.
6. Verify that the **Power** LED is illuminated on the replaced power supply unit.

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Appendix A: Standards & Protection

This Appendix lists the standards with which the D400 Substation Gateway has been tested for compliance.

Compliance standards

Compliance standards are listed for the following categories:

- Emission standards
- Immunity Standards
- Safety Publications
- Environmental Standards
- Communication Standards

Category	Standard Name	Description	Test Specification
Emissions Standards	EN55011 (CISPR 11)[1]	ISM RF equipment – Electromagnetic disturbance characteristics	Radiated Emissions 30 MHz to 1 GHz Conducted Emissions 150 kHz – 30 MHz
	IEC 60255-25	Electromagnetic emission tests for measuring relays and protection equipment	
	IEC 61000-3-2	Limits for harmonic current emissions (equipment input current <= 16 A per phase)	
	IEC 61000-3-3	Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with input current <= 16 A per phase and not subject to conditional connection	

Category	Standard Name	Description	Test Specification
Immunity Standards	IEC 61000-4-2 IEC 60255-22-2 IEEE® C37.90.3	Electrostatic discharge (ESD) immunity test	
	IEC 61000-4-3 IEC 60255-22-3 IEEE C37.90.2 (10 V/m)	Radiated, radio-frequency electromagnetic field immunity test	
	IEC 61000-4-4 IEC 60255-22-4 IEEE C37.90.1	Electrical fast transient/burst immunity test	
	IEC 61000-4-5	Surge immunity test	
	IEC 61000-4-6 IEC 60255-22-6	Immunity to conducted disturbances, induced by radio-frequency fields	
	IEC 60255-22-1	1 MHz burst immunity test	
	IEC 61000-4-8	Power frequency magnetic field immunity test	
	IEC 61000-4-12	Ring wave immunity test	
	IEC 60255-22-1 Ontario Hydro A-28M-82	Damped Oscillatory and Ring wave	
	IEEE C37.90.1	Oscillatory SWC Waveform Immunity	
	IEEE C37.90.1	Temperature Testing: Operational Test	
	IEEE C37.90.1	Temperature Testing: Non-operational Test	
	IEC 61000-4-11	Voltage dips, short interruptions and voltage variations immunity tests	
	IEC 61000-4-16	Test for immunity to conducted, common mode disturbances in the frequency range 0 Hz to 150 kHz	
	IEC 61000-4-17	Ripple on DC input power port immunity test	
	IEC 61000-4-18	Damped oscillatory wave immunity test	
	IEC 61000-4-29+	Voltage dips, short interruptions and voltage variations on DC input power port immunity test This standard only applies when using high voltage DC as the source (100 VDC to 300 VDC).	
	IEC 60255-11	Interruptions to and alternating component (ripple) in DC auxiliary energizing quantity of measuring relays	

Category	Standard Name	Description	Test Specification
Safety Publications	IEC 61010-1	Safety requirements for electrical equipment for measurement, control and laboratory use - General requirements	
	IEC 60255-5	Insulation coordination for measuring relays and protection equipment-Requirements and tests	
Environmental Standards	IEC 60068-2-1	Cold	2 hours non powered, soak at –40 °C, then warm to –20 °C and leave powered for 16 hours
	IEC 60068-2-2[2]	Dry Heat	16 hours powered at +70 °C
	IEC 60068-2-6 IEC 60255-21-1	Vibration (sinusoidal)	A logarithmic sweep from 10 Hz to 150 Hz to 10 Hz at 1 oct/min for 1 sweep cycle in the 3 orthogonal axes. Acceleration level 1 g
	IEC 60068-2-27	Shock - Operating Response Test Shock - Non-Operating Withstand Test	Pulse shape: Half sine Pulse duration: 11 mS - Operating Response Test: Acceleration level: 5 g's - Non-Operating Withstand Test: Acceleration level: 15 g's 3 pulses per polarity per axis for a total of 18 pulses
	IEC 60068-2-29	Bump – Non operating test	Pulse shape: Half sine Pulse duration: 11 mS Acceleration level: 10 g's 1000 pulses per polarity per axis for a total of 6000 pulses
	IEC 60068-2-30	Damp heat, cyclic (12 h + 12 h cycle)	
	IEC 60068-2-31	Drop and topple	Dropping on each face Dropping on each corner Toppling (or pushover) For a total of 12 drops
	IEC 60068-2-78	Humidity Testing	96 hours steady state humidity at 40 °C & 93% RH
	IEC 60255-21-2	Shock and bump tests	
	IEEE 1613, Section 4.1.1	Power Supply Temperature Testing Operational	Temperature range: –20 °C to +70 °C
	IEEE 1613, Section 4.1.1	Power Supply Temperature Testing Non-operational	Temperature range: –40 °C to +85 °C
Communication Standards	IEEE 802.3	CSMA/CD Access Method (and physical layer specifications)	
	IEC 61850-3	Communication networks and systems in substation – General requirements	
	IEEE 802.3	CSMA/CD Access Method (and physical layer specifications)	

[1] To comply, the D400 Substation Gateway BIOS Spread Spectrum clock setting must be set to “disable”. This is the factory default.
[2] To comply, the D400 Substation Gateway BIOS DRAM clock setting must be set to “HCLK-33M”. This is the factory default.

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Appendix B: List of Acronyms

Acronym Definitions

This Appendix lists and defines the acronyms used in this manual.

Acronym	Definition
A	Amperes, unit of measure
AEL	Accessible Emission Limit
ANSI	American National Standards Institute
AWG	American Wire Gauge, unit of measure
bps	Bits per second, unit of measure
CCU	Central Control Unit
CE Mark	Mandatory conformity mark for products placed on the market in the European Economic Area (EEA)
CISPR	Special international committee on radio interference
CMOS	Complementary Metal Oxide Semiconductor
COM1/COM2	Communications port
CPU	Central Processing Unit
CSR	Certificate Signing Request
dBm	Decibel-milliwatt, unit of measure - an electrical power unit in decibel (dB)
DCD	Data Carrier Detect
DCE	Data Communications Equipment
DFR	Digital Fault Recorders
DTE	Data Terminal Equipment
EIA	Electronic Industries Alliance
EMC	Electromagnetic Capability
EMI	Electromagnetic Interference
EPUP	Environmental Protection Use Period
ESD	ElectroStatic Discharge
EU	European Union

Acronym	Definition
FDIR	Fault Detection, Isolation, and Restoration
FPGA	Field-Programmable Gate Array
GE	General Electric
GUI	Graphical User Interface (also called Human Machine Interface – HMI)
HCMOS	High-speed CMOS
HCS	Hard Clad Silica
HMI	Human Machine Interface (also called Graphical User Interface – GUI)
HTTP	HyperText Transfer Protocol
HTTPS	Designated the use of HTTP but with a different default port and an additional encryption/authentication layer between HTTP and TCP
Hz	Hertz, unit of measure for frequency
IEC	International Electrotechnical Commission Standards
IED	Intelligent Electronic Device
ILS	Instrument Landing System
in-lb	Inch-pound, unit of measure for energy
IRIG-B	Inter Range Instrumentation Group (IRIG) - an American standardized network time code format
JRE	JAVA Runtime Environment
JVM	Java Virtual Machine
Kbps	Kilo bits per second, unit of measure
KVM	Keyboard, Video, Mouse
kVRMS	kilo Volts (root mean square), unit of measure
LAN	Local Area Network
lb	Pound, unit of measure for weight
LED	Light Emitting Diode
LTC	Load Tap Changer
Mb	Mega bits, unit of measure
MB	Mega bytes, unit of measure
Mbps	Mega bits per second, unit of measure
MBps	Mega bypes per second, unit of measure
MCV	Maximum concentration values
MDI	Medium Dependent Interface
MDIX	Medium Dependent Interface, Crossover
MOS	Metal oxide semiconductor
ms	milli-seconds, unit of measure
Nm	Newton-meter, measure of energy
NTP	Network Time Protocol
NVRAM	Non-Volatile Random Access Memory
PC	Personal Computer
PLC	Programmable Logic Controllers
POF	Plastic Optical Fiber
PPP	Point-to-point protocol
PTC	Positive Temperature Coefficient
RMA	Return Merchandise Authorization
RoHS	Restriction of Hazardous Substances
RTU	Remote terminal unit
Rx	Receive

Acronym	Definition
SCADA	Supervisory Control and Data Acquisition
SCP	Secure Copy Program (SCP
SNTP	Standard Network Time Protocol
SOE	Sequence of Events
SQL™	Structured Query Language
SSH	Secure Shell
SSL	Secure Sockets Layer
SVGA	Super Video Graphics Array
TIA	Telecommunication Industries Association
TCP/IP	Transmission Control Protocol - Internet Protocol
TLS	Transport Sockets Layer
TTL	Transistor-Transistor Logic
Tx	Transmit
UNC	Unified coarse thread
UNF	Unified fine thread
URL	Universal Resource Locator
USB	Universal Serial Bus
UTP	Unshielded Twisted Pair
VA	Volt Amps, unit of measure
VAC	Volts, Alternating Current, unit of measure
VDC	Volts, Direct Current, unit of measure

GE Energy

D400 Substation Gateway

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Modification Record

Version	Rev.	Date	Author	Change Description
1.00	0	July 12, 2006	S. Tessari	Document created
	1	Nov. 17, 2006	E. Stuhr S. Tessari	Revisions as required by TUV. Deleted Supported Devices sections. Moved signal definitions to Chapter 4 and added more connections information. Edited whole document for consistency and correctness to current product specs. Added Chapter "Setting Up the D400."
	2	Dec. 20, 2006	S. Tessari	Converted to single-source
		Feb. 28, 2007	S. Tessari	Added RoHS and recycling info, updated RS-485 channel numbering order
	3	July 31, 2007	S. Tessari	Added chapter 7, updated network interface setup, updated ordering guide. General editing for commercial release.
	4	Sept. 12, 2007	S. Tessari	Updates to hardware platform
	5	Sept. 29, 2007	M. Haska	Revisions to power/system alarms sections and Local HMI functionality
	6	Nov. 29, 2007	M. Haska	Updated required JVM version from 5.0 to 6.0
	7	June 16, 2008	M. Haska	Added 1.0 GHz CPU information
	8	Sept. 10, 2008	M. Haska	Added info on 100Base-FX Hot Standby Fiber Optic Ethernet Adapter
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	1	Feb 17, 2012	R. Rees	Added GE part numbers for CompactFlash to the *Changing the Compact Flash* section.
	2	Mar 20, 2012	R. Rees	Added Appendix B: List of Acronyms